616262

AECOM

Quality Assurance Project Plan

River Mile 10.9 Post-Construction Monitoring
Lower Passaic River Restoration Project
New Jersey

Lower Passaic River Study Area

River Mile 10.9 Post-Construction Monitoring

January 2017

Revision 4

Approved By: _____ Date: January 24, 2017
Debra L. Simmons, Project QA Manager

Approved By: _____ Date: January 24, 2017
Douglas E. Simmons, Task Manager

Contents

List of Acronyms

Acronym	Definition
%D	Percent Difference
%R	Percent Recovery
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
AOC	Administrative Settlement Agreement and Order on Consent
Be-7	Beryllium-7
BCS	Batch Control Spike
CA	Corrective Action
CAS Number	Chemical Abstracts Services Number
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CLH	Chemical Land Holdings
cm	centimeter
COC	Chain of Custody
COPC	Chemical of Potential Concern
CPG	Cooperating Parties Group
CPR	Cardiopulmonary Resuscitation
Cs-137	Cesium 137
ddms	de maximis Data Management Solutions
GPS	Differential Global Positioning System
DMP	Data Management Plan
DoD	Department of Defense
DQI	Data Quality Indicators
DQL	Data Quality Level
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
EDL	Estimated Detection Limit
EDP	Electronic Data Processor
EMBM	Empirical Mass Balance Model
EML	Estimated Minimum Level
fg/L	femtograms per liter
FSP	Field Sampling Plan
FTM	Field Task Manager
g	Gram
GBA	Gahagan & Bryant Associates, Inc.
GLDD	Great Lakes Dredge and Dock
H&S	Health and Safety
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response

List of Acronyms (Continued)

Acronym	Definition
HRGC/HRMS	High Resolution Gas Chromatography-High Resolution Mass Spectrometry
ICAL	Initial Calibration
Kpdms	Polydimethylsiloxane Partition Coefficient
Kpw	Polymer-Porewater Partition Coefficient
Kpom	Polyoxymethylene Partition Coefficient
LIMS	Laboratory Information Management System
LLP	Limited Liability Partnership
LPR	Lower Passaic River
LPRRP	Lower Passaic River Restoration Project
LPRSA	Lower Passaic River Study Area
LRC	Low Resolution Coring
LTCMMP	Long-Term Cap Monitoring and Maintenance Plan
MB	Method Blank
MDL	Method Detection Limit
MEDD	Multi-Media Electronic Data Deliverable
MPC	Measurement Performance Criteria
MPI	Malcolm Pirnie, Inc.
MRT	Material Ratio Tests
N/A	Not Applicable
NA	Not Available
NAD	North American Datum
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Not Detected
ng/L	Nanograms per Liter
NGVD	National Geodetic Vertical Datum
OD	Outer Diameter
OU	Operable Unit
Oz	Ounce
PAH	Polycyclic Aromatic Hydrocarbons
PAL	Project Action Level
PCB	Polychlorinated Biphenyl
PCDD/PCDF	Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans
PDF	Portable Document Format
PDMS	Polydimethylsiloxane
PFK	Perfluorokerosene
pg	Picogram
pg/L	Picogram/liter
pg/sample	Picogram/sample

List of Acronyms (Continued)

Acronym	Definition
PM	Project Manager
POM	Polyoxymethylene
PRC	Performance Reference Compound
PTFE	Polytetrafluoroethylene
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
QMP	Quality Management Plan
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
RM	River Mile
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
S/N	Signal to Noise
SDS	Soxhlet/Dean Stark
SOP	Standard Operating Procedure
SOW	Statement of Work
SSO	Site Safety Officer
SSP	Supplemental Sampling Program
SSP2	Second Supplemental Sampling Program
TBD	To Be Determined
TCDD	Tetrachlorodibenzo-p-dioxin
TCRA	Time-Critical Removal Action
TSA	Technical Surveillance Audit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency

Introduction

This Quality Assurance Project Plan (QAPP) for the Lower Passaic River Study Area (LPRSA) River Mile (RM) 10.9 Post-Construction Monitoring has been prepared pursuant to the Administrative Settlement Agreement and Order on Consent (AOC) for Removal Action, Docket No. 02-2012-2015 (United States Environmental Protection Agency [USEPA], 2012), by the Cooperating Parties Group (CPG). The RM 10.9 AOC became effective on June 18, 2012. The Removal Action was conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as a Time-Critical Removal Action (TCRA). The Removal Action selected by the USEPA is presented in the Action Memorandum/ Enforcement dated May 21, 2012. The goals of the removal action were to reduce exposure to elevated concentrations of chemicals of potential concern (COPCs) in the removal area and to prevent migration of contamination from the removal area to other parts of the river.

This QAPP has been prepared for the first monitoring event (two attempts to complete the first chemical monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction) and a second event approximately five years after cap completion. Based on the results of the first monitoring event, the QAPP may be modified following discussion and agreement by both Region 2 and the CPG for the second monitoring round after approximately five years following completion of cap construction. Additionally if new information becomes available about the science of remedial cap monitoring, the QAPP may be modified following discussion and agreement by both Region 2 and the CPG.

This QAPP describes the initial phase of RM 10.9 Post-Construction Monitoring. This QAPP outlines the sampling, analytical and bathymetry survey procedures and includes details for collection of porewater samples using passive collection methods beneath and within the RM 10.9 cap as well as surface sediment samples above the cap. This QAPP describes the implementation of the sampling, analysis, and associated Quality Assurance (QA) and Quality Control (QC) activities developed for this program.

A similar post-construction monitoring event will be conducted approximately five years after the completion of the removal action. This second monitoring event is anticipated to follow the procedures outlined in this QAPP. These procedures may be modified based on the results of the initial phase of the RM 10.9 Post-Construction Monitoring or if new information becomes available about the science of remedial cap monitoring.

In addition to the routine monitoring described above, event-based physical monitoring (e.g., bathymetric survey and poling) will be performed following river flow events that exceed specified flows or other significant physical disturbances (e.g., adjacent in-river construction activities) that have a high probability of affecting the integrity of the cap.

This document adopts USEPA applicable Uniform Federal Policy (UFP) QAPP Worksheets [Publication Numbers: USEPA: EPA-505-B-04-900A; Department of Defense (DoD): DTIC ADA 427785] (USEPA 2005). This document includes the following components: the QAPP, bathymetry QAPP addendum (Appendix A), field SOPs (Appendix B), and laboratory SOPs (Appendix C).

Background

The removal action implemented at RM 10.9 included dredging of approximately 16,000 cubic yards of surface sediment (top 2 feet) followed by placement of an engineered cap over the removal area which was completed in May 2014. As discussed in the RM 10.9 Removal Action Final Construction Report (CH2MHill, in preparation), the average thicknesses of the active layer and armor layer were 10.5 and 15.2

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inches, respectively. In addition, approximately 6 inches of sand was placed on the cap as a habitat layer to fill the voids in the armor stone and to provide a relatively smooth cap surface with a design goal of no net increase in cap elevation above the armor layer. In areas near shore where hard subgrade was encountered (noted as "rock and hardpan material" including rock armor shoreline protection in the RM 10.9 Removal Action Final Construction Report (CH2MHill, in preparation), the cap design was modified with the approval of USEPA and the average thicknesses of the active layer and armor layer were each approximately 6 inches.

Data Quality Objectives

The RM 10.9 Post-Construction Monitoring was designed to meet two data quality objectives (DQOs):

1. Confirm the physical integrity of the cap, and
2. Confirm the cap modeling predictions with chemical monitoring, including in-situ measurements of sediment porewater.

The main objective of the RM 10.9 Post-Construction Monitoring is to confirm that the cap is performing the basic functions required to meet the removal action objectives. Those functions require that cap integrity, thickness, and consolidation be checked in response to physical processes such as erosion due to high flows, ice scour, flooding, and human activities. Therefore, the physical monitoring described in this QAPP will be performed to ensure that the physical integrity of the armor layer of the cap is maintained such that it continues to protect the active layer. The physical monitoring program described in this QAPP will evaluate the physical integrity of the cap at approximately one year after completion of cap construction to confirm that the cap is physically stable. This initial monitoring event will also provide baseline information on cap construction[1]. Data obtained from this physical monitoring program (e.g., bathymetry and probing of cap layer thicknesses) will also be used in the development of the chemical monitoring included in this QAPP.

The chemical monitoring described in this QAPP was directed by USEPA and includes the sampling of in-situ porewater at three depth intervals to determine the influence of both underlying sediment concentrations and overlying water concentrations on the cap, as well as to confirm that the cap is performing consistent with the cap model projections. This chemical monitoring will also include collection of sediment samples at the surface of the cap to assess potential recontamination from newly-deposited sediment on top of the engineered cap.

The objectives of the RM 10.9 Post-Construction Monitoring are to confirm that the physical integrity of the cap is consistent with the design specifications and that the chemical isolation layer (i.e., "active layer") is

[1] The one year post-construction monitoring bathymetry survey will serve as a baseline for future surveys because: (1) most cap consolidation will typically occur in the first year after construction, so comparison to this survey as a baseline will reflect less on potential consolidation and will reflect more on other potential cap changes, e.g., erosion or deposition; and (2) this survey has been specifically designed (e.g., survey lines and line spacing) for post-construction monitoring and future surveys will use the same line spacings and, to the extent practical, use the same line locations.

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functioning as designed. These two lines of evidence (physical integrity and chemical isolation) provide direct empirical measurements to validate that the cap is functioning as designed and therefore is sufficient to ensure protection of human health and the environment.

This QAPP includes an initial physical monitoring event and a baseline chemical monitoring event (two attempts to complete the first chemical monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction). A second post-construction monitoring event will be conducted approximately five years after the completion of the Removal Action. The QAPP will be updated, as necessary, for this second event based on the results of this initial monitoring event and any advancements in porewater monitoring technology or techniques as long as the modifications allow for comparability with existing data.

This QAPP also includes event-based physical monitoring (e.g., bathymetric survey and poling) that will be performed following river flow events or anthropogenic disturbances that could affect the integrity of the cap. The RM 10.9 flows are approximated using discharge measurements from the United States Geological Survey (USGS) gage station at Little Falls and a drainage-area proration to estimate discharge at Dundee Dam (approximately 7 percent higher than Little Falls). Flow rates corresponding to recurrence intervals ranging from 5 years to 100 years are presented in Table 1 below.

Table 1 Summary of Designated Lower Passaic River Flow Events

Recurrence Interval	Discharge at Little Falls (cfs)	Approximate Discharge at Dundee Dam (cfs)
5 years	10,500	11,000
10 years	13,000	14,000
25 years	16,000	17,000
50 years	19,000	20,500
75 years	20,500	22,000
100 years	22,000	23,500
cfs = cubic feet per second		

As the armor layer of the cap was designed for the 100-year event, the initial event-based physical monitoring will be performed within 1 to 2 months (when feasible) following a storm event where the river flow exceeds the 50-year return period flow as a conservative measure. Specifically, daily average flow exceeding 19,000 cfs at Little Falls will be used to trigger the initial event-based bathymetric survey. If the cap is shown to remain intact following the initial 50-year return period flow event, the second event-based monitoring will be triggered after the 75-year return period flow event is exceeded. Subsequent event-based physical monitoring will only be triggered each time the design (100 year) flow event is exceeded. If the initial or second event also exceeds the 100-year return period flow and the cap is shown to remain intact, subsequent event-based physical monitoring will only be triggered each time the 100-year flow event is exceeded.

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As noted in the Final Design (CH2M Hill, 2013), the cap is expected to remain generally intact even if the 100-year return period flow is exceeded. The velocities and associated erosive forces across the river are not uniform; the highest velocities used for design occur over only small portions of the cap. Thus, the vast majority of the cap is expected to withstand flows that are higher than the 100-year return period flood.

In addition to flow events, nearby in-river construction activities (e.g., bridge or utilities) or anthropogenic disturbances (e.g., vessel grounding) that could directly or indirectly negatively impact the cap's physical integrity and/or cause significant cap erosion can trigger monitoring.

A significant cap elevation differential (i.e., detectable within the sensitivity of the bathymetric survey) between the previous hydrographic surveys and the most recent hydrographic survey will require evaluation and discussion with Region 2.

Proposed Program

The proposed initial monitoring program will include the following activities.

Physical Monitoring

Bathymetry Survey - A single beam bathymetry survey of the 4.3-acre RM 10.9 cap, located approximately between RM 10.74 to RM 11.16, was conducted June 8 and 9, 2015. Single beam data will be collected as the majority of the cap is in areas of shallow water depth where the multi-beam equipment cannot operate. The single beam survey will be performed consistent with previous USEPA-approved single beam surveys performed by the CPG. The accuracy of the single beam bathymetric survey of +/- 0.3 meters is the accuracy for bathymetry surveys used for the project. Given this accuracy, the bathymetry survey will provide gross changes in bathymetry since the time of cap construction. The bathymetric survey will be conducted of the cap area and will extend from approximately 100 feet upstream and downstream of the cap and from the shoreline (estimated at the mid tide elevation) to 100 feet from the edge of the cap into the river channel. Figure 1 shows the area of the proposed bathymetric survey. The bathymetric survey will be conducted at a time as close to high tide as possible in order to extend the survey lines as close to the high water line over the capped area as can be obtained while maintaining the safe navigation of the survey vessel and ensure lock on the differential global positioning system (GPS) satellite constellation. Single beam cross sections will be taken at 25 foot intervals and perpendicular to the channel centerline and with three tie-lines running parallel to the shore.

Probing – Probing of cap layer thicknesses will be conducted at each proposed chemical monitoring station. Based on the results of preliminary probing conducted on April 20 and 21, 2015 (as discussed in the May 4, 2015 Field Activity Results Summary, LPR River Mile 10.9 Initial Reconnaissance), the probing (utilizing a drive point probe advanced with a slide hammer) will be able to determine the thickness of the combined habitat layer above the armor layer and any sediment deposited since cap construction and the thickness of the armor layer. After the probe rod penetrated the armor layer and the geotextile, the active layer and underlying sediments provided a similar resistance to probing, so the probing was not able to distinguish between the active layer and the underlying sediments during the April 20 and 21, 2015 field work.

Poling – Poling for the presence of the armor layer will be conducted along transects oriented perpendicular to the shore and through each chemical monitoring station. Poling (utilizing a solid rod or pipe pushed by hand through the overlying accumulated sediment and habitat layer) will be able to determine the presence

Introduction (continued)

or absence of the armor layer. Poling of the RM 10.9 QAPP will be performed at the frequency described in the River Mile 10.9 Removal Action Long-Term Monitoring and Maintenance Plan (RM 10.9 LTMMP) (AECOM, 2017).

Chemical Monitoring

Passive Sampling - Passive samplers using polymer coating on SPME fibers were selected to ensure that only the COPCs truly dissolved in porewater are measured. Passive sampling reduces matrix interferences and eliminates the whole water analysis problem of including colloidally bound and COPCs sorbed to organic carbon. When the COPCs have equilibrated between the source sediment, dissolved organic carbon, porewater, and the polymer sorbent on the SPME fibers, then the polymer sorbent concentration can be used to calculate the porewater concentration if reliable partition coefficients for the polymer are available. Passive sampling dramatically improves the sensitivity of porewater analysis for hydrophobic COPCs because the polymer partitioning coefficient acts as a multiplier, lowering detection limits. The thin polymer coating on the SPME fiber usually equilibrates within a few weeks and negligibly depletes the surrounding porewater of COPCs. The COPCs are expected to be fully equilibrated within 30 days. The planned minimum time for sampler deployment has been expanded to 60 days to ensure that COPC equilibrium has been reached. Deployment may exceed 60 days depending on the optimal tide conditions for placement and retrieval.

Sample Locations – Sample locations were selected to be accessible by walking across the cap and spatially distributed across the cap area, and include a location of higher upwelling, locations where sediment samples beneath the cap exhibited relatively higher concentrations of the COPCs compared to other areas of the cap, and locations in areas adjacent to the utility area where a cap was not installed (see Figures 2 through 5). Three additional locations requested by USEPA, for a total of ten locations, are included in this initial event. Based on the results of the preliminary probing conducted on April 20 and 21, 2015 (as discussed in the May 4, 2015 Field Activity Results Summary, LPR River Mile 10.9 Initial Reconnaissance) and the presence of the armor and geotextile layers in the cap design, insertion of the samplers using either a boat-based platform or divers was deemed not feasible because (1) a slide hammer is required to advance the probe and sampler through the armor and geotextile layers, which is not feasible with divers, (2) the current and shallow water also make the use of divers not feasible, and (3) the delicate nature, small scale, and the need to install multiple samplers in a small area to finely defined depths through the armor and geotextile layers while holding a sample vessel on station makes use of a boat-based platform not feasible. Therefore, the preferred method to install the sampling devices is to access the locations on foot during a low tide. For this reason some locations may not be accessible at the time of sampling and may need to be modified at the time of sampler placement. Close and constant coordination between the CPG and USEPA will be maintained during field activities. This coordination will help to ensure that any proposed major deviations from the work plan, including changes in sample location, can be reviewed by USEPA and, if acceptable, approved in “real time” prior to implementation.

On December 1, 2015, USEPA in collaboration with the CPG identified adjusted sample locations based on projected water levels and the CPG’s stated field constraints (e.g., accessing locations on foot, no in-water work or wading, etc.). During a conference call on December 4, 2015, the CPG agreed to make a best effort to safely access these locations during the December 9, 10, and 11 sampler deployments. These USEPA proposed locations are shown on Figure 6. These locations were also the target locations for the June 2016 sampler deployments.

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Sample Depths – Porewater samples using passive sampling devices (Solid Phase Microextraction [SPME] samplers) will be collected through an approximate 5-inch screened interval (based on screened interval of sampling device being used [AMS Soil Vapor Probe and Henry Sampler], cap layer thicknesses, and length of SPME fibers required for analysis) at three depth intervals, (see Figure 7): underlying sediments (approximately 31 to 36 inches below the top of the cap), cap active layer (approximately 15 to 20 inches below the top of the cap), and armor layer (approximately 2 to 7 inches below the top of the cap). These depths are approximate and may be adjusted following review of the bathymetric survey results for evidence of consolidation or erosion as confirmed by the probing survey. Any changes to the sampling depths based on these surveys will be provided to Region 2 for review and approval. Each sampler will be deployed in a separate modified Henry sampler to avoid cross-contamination between depth intervals. The samplers will be inserted into the cap in a triangular pattern (one for each of the three depths) as close as possible, and within approximately 2 feet of each other. The precise location of the samplers will depend on the results of the probing and ability to penetrate to the desired depth. As stated above, probing cannot distinguish between the active layer and underlying sediments. Therefore the top of screened interval of the active layer SPME sampler will be installed immediately (e.g., 1 inch) below the armor layer/geotextile and the top of screened interval of the underlying sediment SPME sampler will be installed at a depth below the geotextile based on the as-constructed thickness of the active layer (approximately 10 inches) plus 6 inches."

In addition to these porewater samples, a surface grab sediment sample will be collected at each sample location. These surface samples will be collected from the soft sediments deposited on top of the sand habitat layer and will include collection of sediment from the full thickness of the soft sediments above the habitat layer. If soft sediments are not present at a location, or cannot be distinguished from the sand habitat layer, the surface sediment samples will be collected from the sediment surface (approximately 0 to 3 inches) to focus the sampling at the sediment surface where potential newly deposited sediment may be present and not sample the bottom portion of the clean sand of the habitat layer. The surface sediment samples will be collected at locations as close as possible to the armor layer SPMEs (outside the area of the 4-inch diameter metal plates used for re-locating the SPME samplers), but no more than 8 inches from the armor layer SPME locations.

All site sampling activities will be conducted at low tide when the sampling locations are accessible by foot.

Analytes - The RM 10.9 Post-Construction Monitoring includes the following three constituents and analytical methods:

- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) using USEPA Method 1613B
- 2,2',5,5'-Tetrachlorobiphenyl (PCB 52) using USEPA Method 1668C
- Phenanthrene using modified California USEPA Air Resources Board Method 429

These compounds are the three COPCs that were used in the cap design. High Resolution Gas Chromatography and High Resolution Mass Spectrometry (HRMS/HRGC) and isotope dilution will be used to maximize the analytical sensitivity and accuracy. Analyte mass in the SPME fibers will be reported by the laboratory on a picogram (pg)/sample basis. Results for analyte mass will be converted to porewater concentrations using published literature values for partition coefficients for the polydimethylsiloxane (PDMS) sorbent on the SPME fibers. Partition coefficients for phenanthrene and PCB-52 selected were provisional Kpw values from the recent SETAC Technical Workshop "Guidance on Passive Sampling

Introduction (continued)

Methods to Improve Management of Contaminated Sediments" documents (Ghosh, 2014). The PDMS partition coefficient for 2,3,7,8-TCDD was derived by Cornelissen from polyoxymethylene (POM) experimental values and a Kpdms-Kpom linear free-energy relationship derived for polycyclic aromatic hydrocarbons PAHs (Cornelissen, 2010).

Introduction (continued)

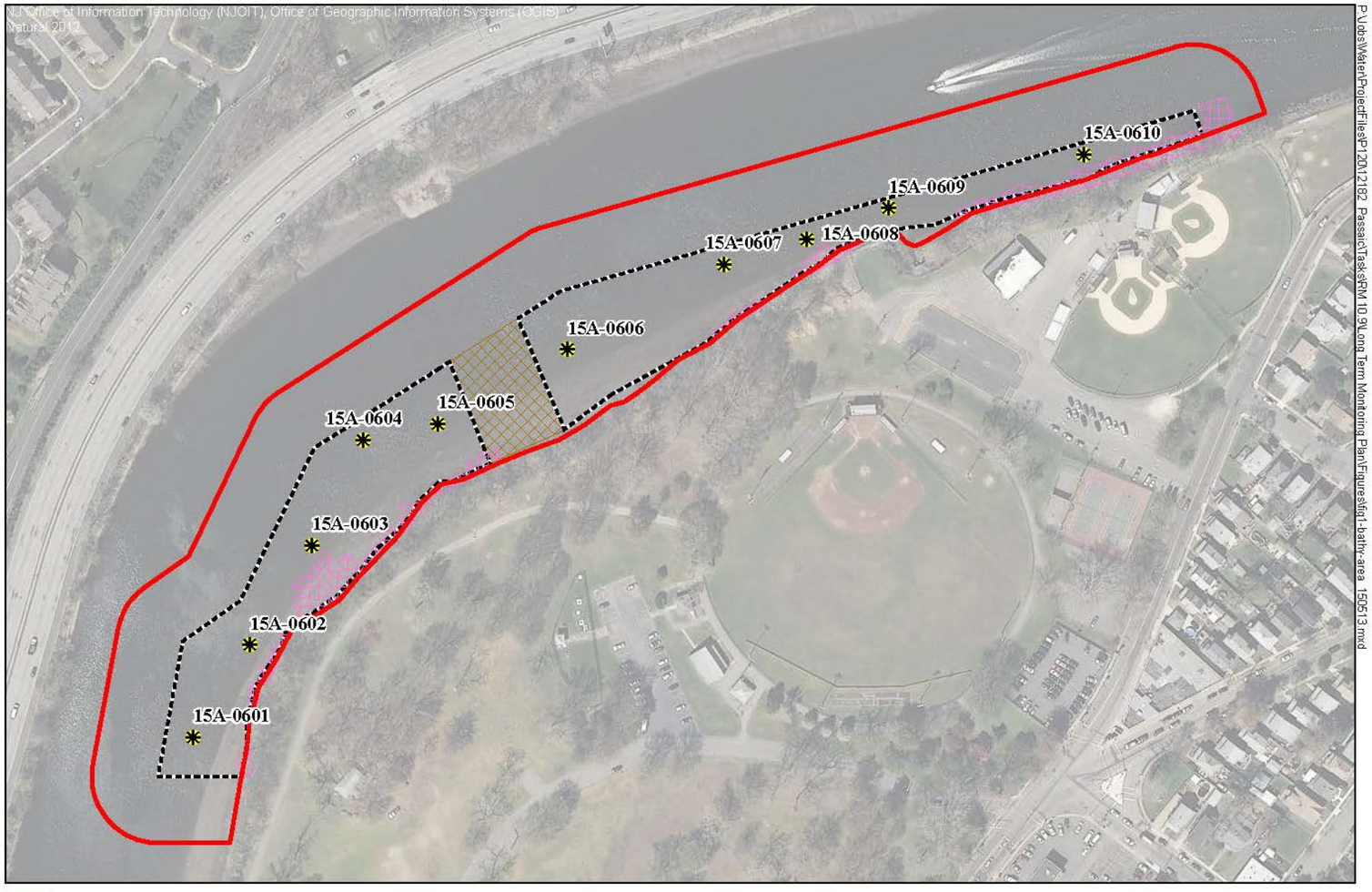


Figure 1
Proposed Bathymetry Area and Sampling/Probing Locations

Introduction (continued)

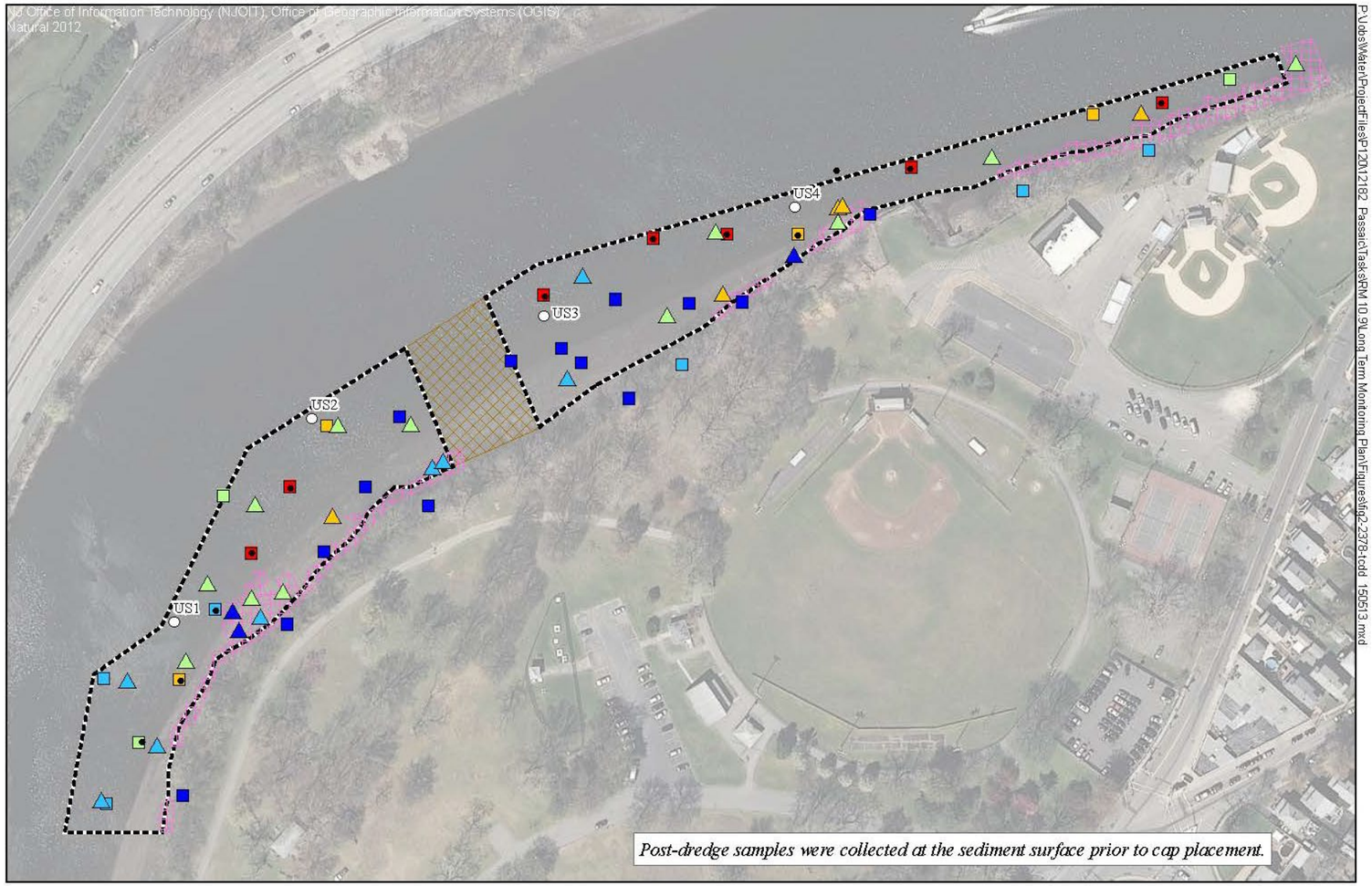


Figure 2
Sediment Sample Results Below Cap
2,3,7,8-TCDD

Introduction (continued)

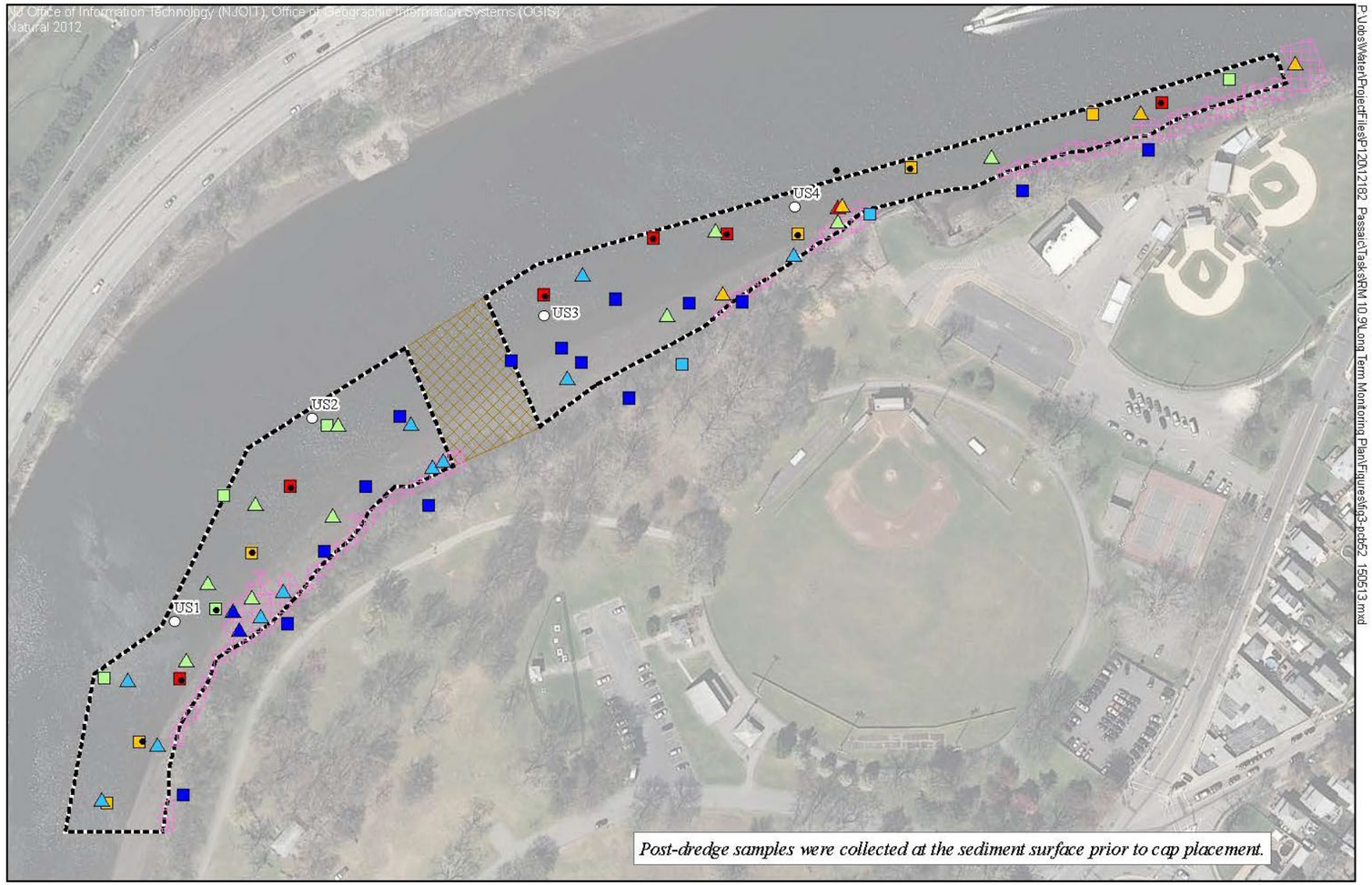


Figure 3
Sediment Sample Results Below Cap
PCB-52

Introduction (continued)

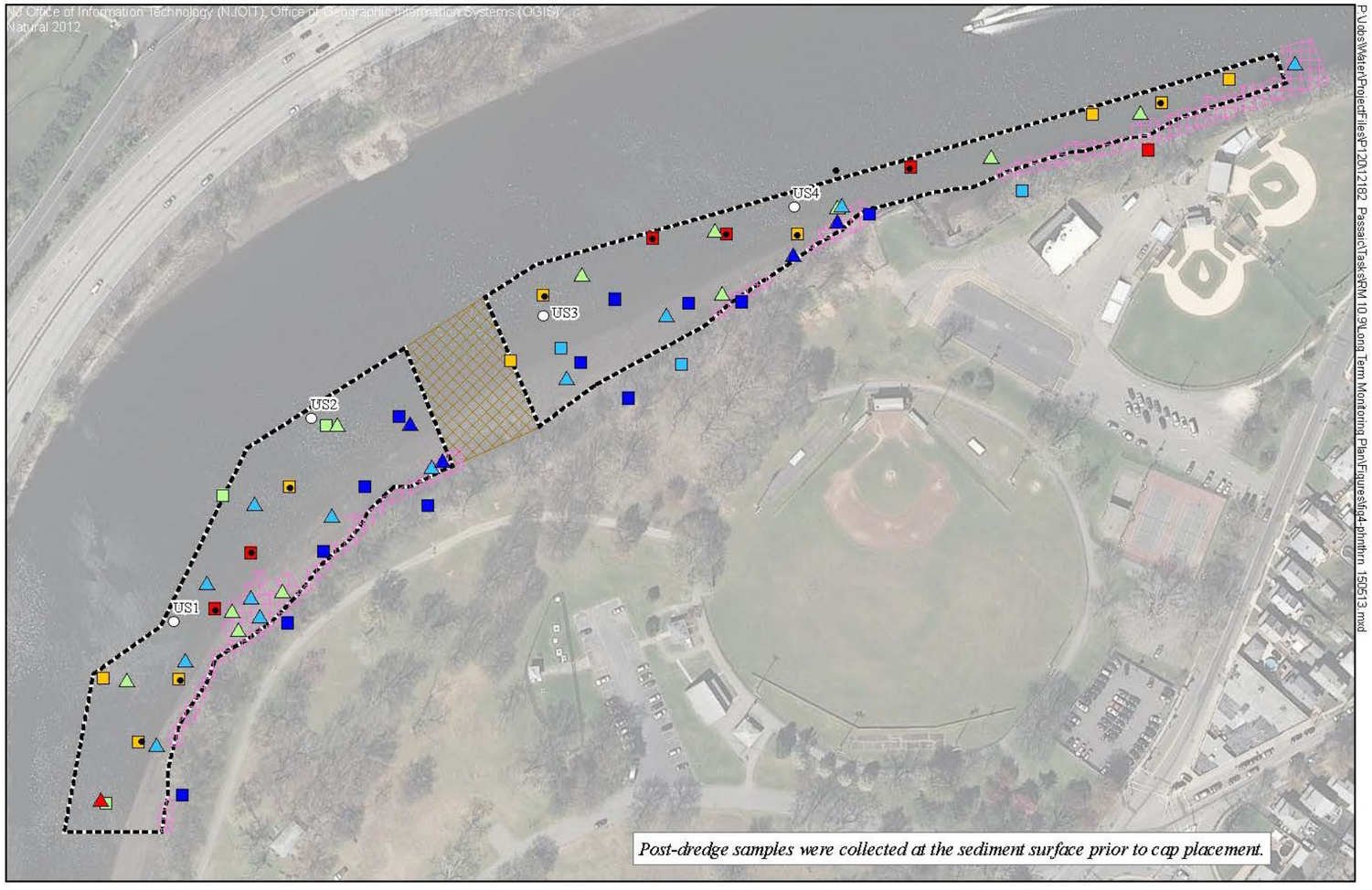


Figure 4
Sediment Sample Results Below Cap
Phenanthrene

Introduction (continued)

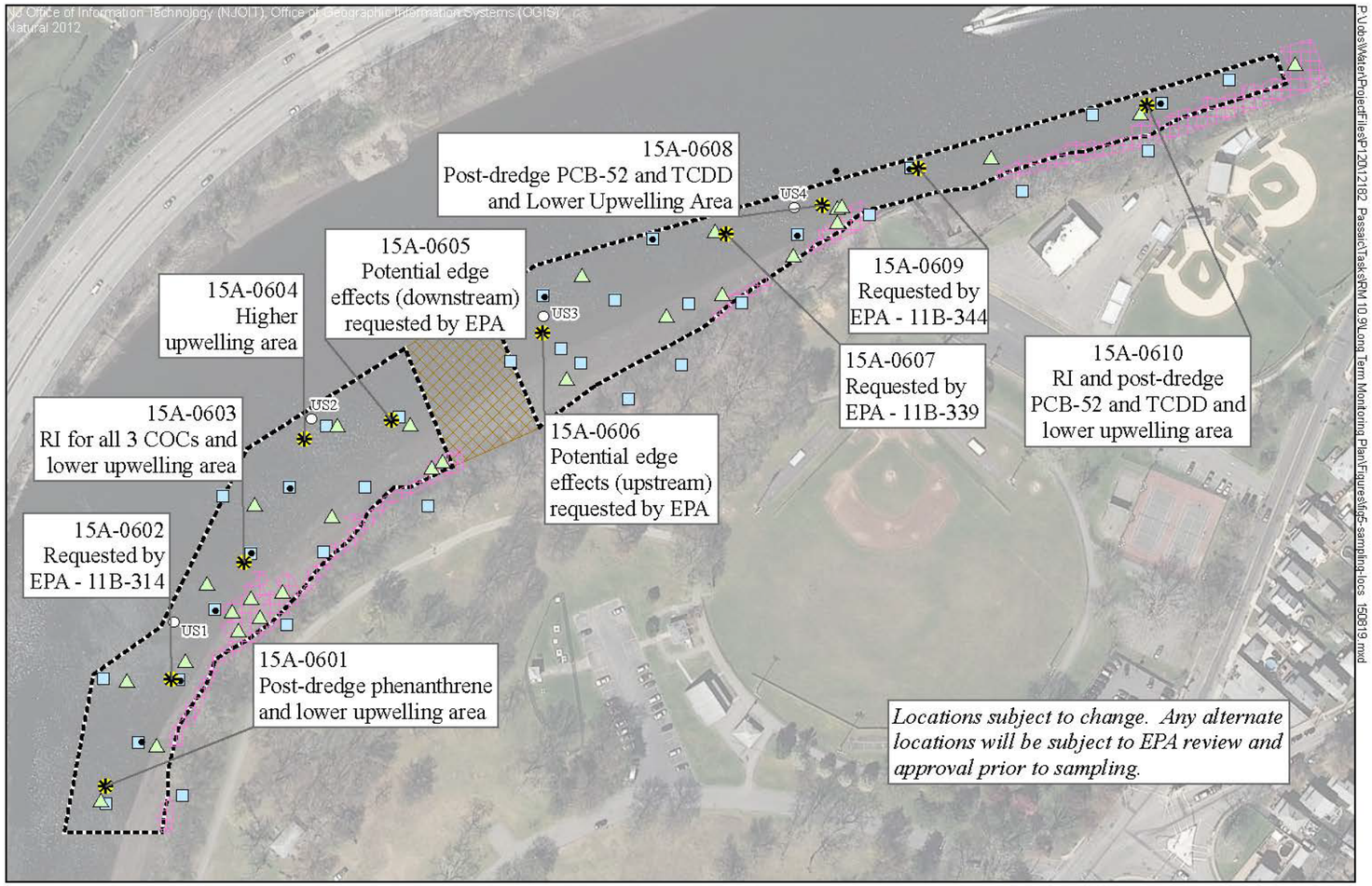
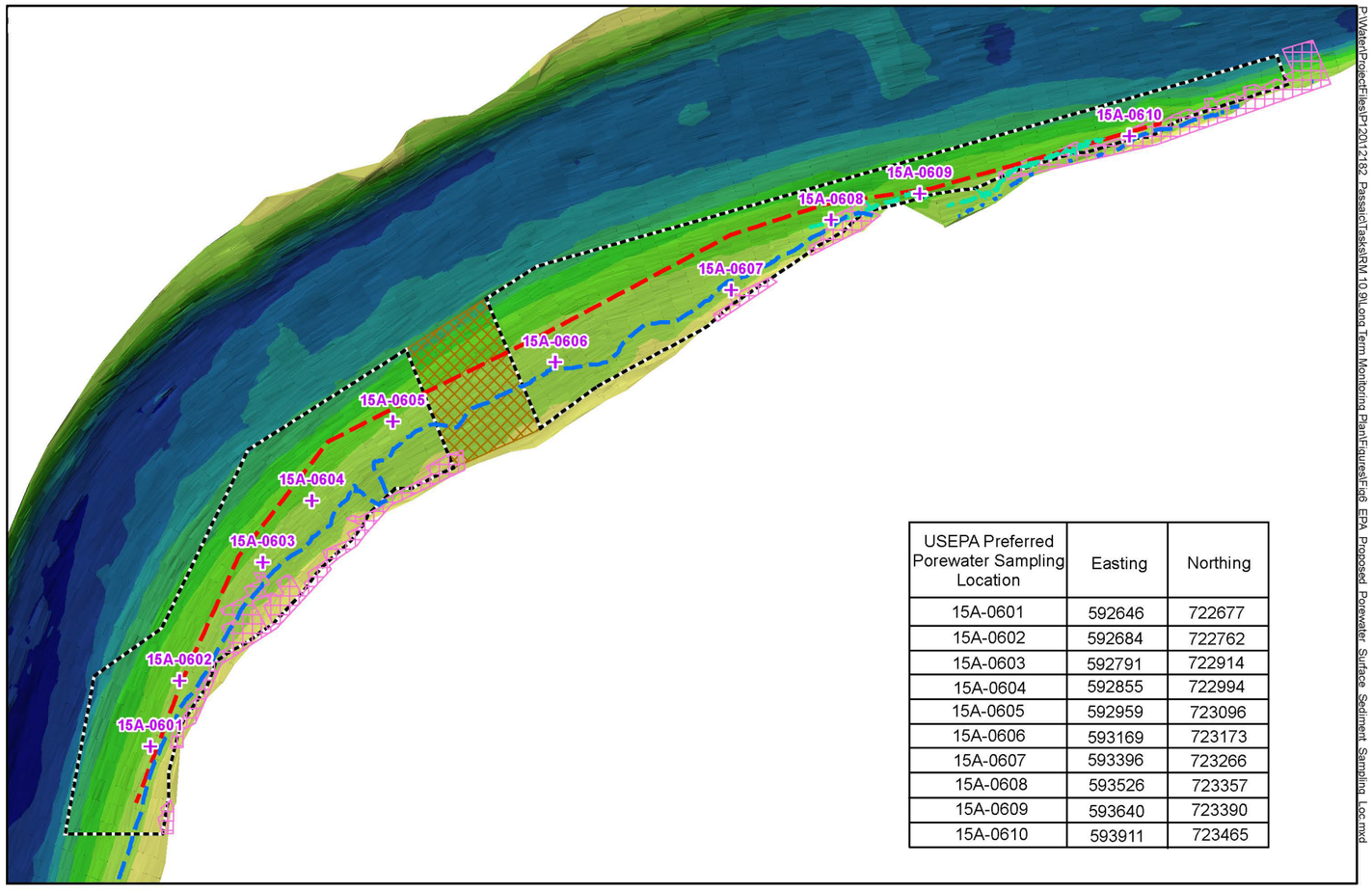


Figure 5
Proposed Porewater and Surface Sediment Sampling Locations

Introduction (continued)



USEPA Preferred Porewater Sampling Location	Easting	Northing
15A-0601	592646	722677
15A-0602	592684	722762
15A-0603	592791	722914
15A-0604	592855	722994
15A-0605	592959	723096
15A-0606	593169	723173
15A-0607	593396	723266
15A-0608	593526	723357
15A-0609	593640	723390
15A-0610	593911	723465

USEPA's Proposed Porewater and Surface Sediment Sampling Location
Approximate Low Water Line, 12/10-13/15 at a tide elevation of -0.6 ft relative to MLLW
Approximate Low Water Line, 8/27/15 at a tide elevation of 0.3 ft relative to MLLW
Approximate Low Water Line, 9/29/15 at a tide elevation of -0.95 ft relative to MLLW
Dredge/Cap Area
No Dredge Area
Hard Pan

Elevation Bathymetry survey by GBA, June 2015 measured in feet NGVD 29

0.08 - 2.29	
-2.13 - 0.08	-10.97 - -8.76
-4.34 - -2.13	-13.18 - -10.97
-6.55 - -4.34	-15.39 - -13.18
-8.76 - -6.55	-17.6 - -15.39

0 50 100 200 300 Feet

Figure 6
USEPA's Proposed Porewater and Surface Sediment Sampling Locations

Introduction (continued)

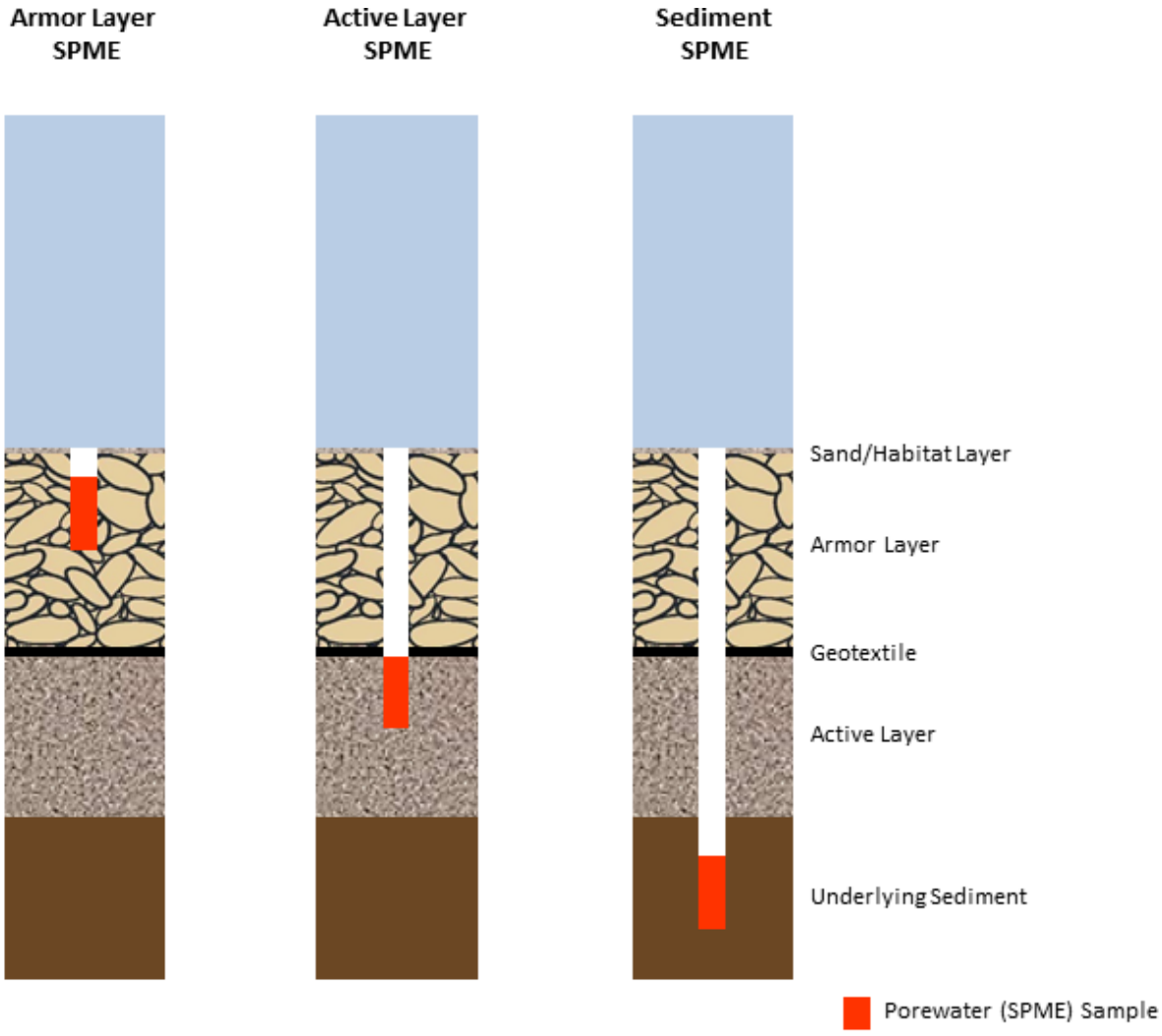


Figure 7 Conceptual Porewater Sampling Depth

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) Title and Approval Page

Document Title: Quality Assurance Project Plan, River Mile 10.9 Post-Construction Monitoring, Lower Passaic River Restoration Project

Lead Organization: CPG and de maximis, inc.

Preparer's Name and Organizational Affiliation: Doug Simmons, AECOM

Preparer's Address and Telephone Number:

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978-905-2401

Preparation Date (Day/Month/Year): Revision 0, June 2015; Revision 1, December 2015; Revision 2, April 2016; Revision 3, August 2016; Revision 4, January 2017

Investigative Organization's Project Manager	Laura Kelmar / AECOM / January 2017
Investigative Organization's Project QA Manager	Debra Simmons / AECOM / January 2017
Lead Organization's Project Manager	Bill Potter / Robert Law / de maximis, inc. / January 2017

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Site Name/Project Name: Diamond Alkali Operable Unit (OU) 2 – Lower Passaic River Restoration Project (LPRRP) Remedial Investigation/Feasibility Study (RI/FS)

Site Location: LPRSA, New Jersey
Site Number/Code: CERCLA Document No. 02-2007-2009
Operable Unit: OU 2
Contractor Name: AECOM
Contractor Number: Not Applicable (N/A)
Contract Title: N/A
Work Assignment Number: N/A

1. Identify guidance used to prepare QAPP:

   Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. Final Version 1. March 2005. Intergovernmental Data Quality Task Force (US Environmental Protection Agency, US Department of Defense, US Department of Energy). USEPA 505-B-04-900A.

2. Identify regulatory program: CERCLA

3. Identify approval entity: USEPA Region 2

4. Indicate whether the QAPP is a generic or a project-specific QAPP (circle one)

5. List dates of scoping sessions that were held: December 19, 2013, November 19, 2014, April 1, 2015, and July 29, 2015.

6. List dates and titles of QAPP and Field Sampling Plan (FSP) documents written for previous site work, if applicable:

Title
Chemical Land Holdings (CLH) 1995. *Work Plan, Vol. 1 of Passaic River Study Area Remedial Investigation Work Plans*. Chemical Land Holdings (now Tierra Solutions, Inc.), Newark, NJ. January 1995.
Tierra Solutions, Inc. 1999. *Passaic River Study Area Ecological Sampling Plan. Quality Assurance Project Plan.* March 1999.
Malcolm Pirnie, Inc. (MPI) 2005a. *Lower Passaic River Restoration Project. Work Plan.* Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.
MPI 2005b. *Lower Passaic River Restoration Project. Revised preliminary Draft Field Sampling Plan.* Volume 3. Prepared for US Environmental Protection Agency and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY
MPI 2005c. *Lower Passaic River Restoration Project. Quality Assurance Project Plan.* Prepared for US Environmental Protection Agency and US Army Corps of Engineers. MPI, White Plains, NY.
MPI 2006a. *Lower Passaic River Restoration Project. Field Sampling Plan.* Volume 1. Prepared for US Environmental Protection Agency, US Army Corps of Engineers. MPI, White Plains, NY.

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Title
MPI et al. 2006b. *Lower Passaic River Restoration Project. Field Sampling Plan.* Volume 2. Prepared for US Environmental Protection Agency, US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.
MPI 2007c. *QAPP/FSP Addendum for Lower Passaic River Restoration Project Empirical Mass Balance Evaluation*. December 2007.
ENSR 2008. *Lower Passaic River Restoration Project RI/FS. Quality Assurance Project Plan. RI Low Resolution Coring/Sediment Sampling*. Revision 4. ENSR, Westford, MA. October 2008.
AECOM 2008. *Lower Passaic River Restoration Project. Bathymetric Surveys. Quality Assurance Project Plan*. AECOM, Westford, MA. October 2008.
Windward 2009a. *Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Fish and Decapod Crustacean Tissue Collection for Chemical Analysis and Fish Community Survey*. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA. August 2009.
Windward 2009b. *Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing*. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. October 8, 2009. Windward Environmental LLC, Seattle, WA. October 2009.
AECOM 2010b. *Quality Assurance Project Plan/Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring. Lower Passaic River Restoration Project.* Revision 4. AECOM, Westford, MA. March 2010.
Tierra Solutions, Inc. 2010. *Combined Sewer Overflow/Stormwater Outfall Investigation Quality Assurance Project Plan. Lower Passaic River Study Area*. Revision 0. July 2010.
AECOM 2011b. *Quality Assurance Project Plan. Lower Passaic River Study Area. River Mile 10.9 Characterization.* Revision 3. AECOM, Chelmsford, MA. October 2011.
AECOM 2012a. *Quality Assurance Project Plan. Lower Passaic River Study Area Low Resolution Coring Supplemental Sampling Program*. Revision 3. AECOM, Chelmsford, MA. June 2012
AECOM 2012b. *Quality Assurance Project Plan/Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/Small Volume Chemical Data Collection. Lower Passaic River Restoration Project*. Revision 3. AECOM, Chelmsford, MA. July 2012
AECOM 2012c. *Quality Assurance Project Plan/Field Sampling Plan Addendum. Remedial Investigation Water Column Monitoring/High Volume Chemical Data Collection. Lower Passaic River Restoration Project*. Revision 2. AECOM, Chelmsford, MA. December 2012
AECOM 2013. *Quality Assurance Project Plan. Lower Passaic River Study Area Low Resolution Coring Second Supplemental Sampling Program*. Revision 1. AECOM, Chelmsford, MA. September 2013
CH2M Hill 2013. RM 10.9 Removal Action Final Design Report. May 2013.
CH2MHill 2014. RM 10.9 Removal Action Final Construction Report. in preparation)

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

7. List organizational partners (stakeholders) and connection with lead organization:

   This work will be performed under the requirements of the Settlement Agreement and Statement of Work (SOW) with oversight conducted by USEPA and its government partners. de maximis, inc. (acting as Project Coordinator for the CPG), AECOM, and its subcontractors, are conducting the work on behalf of the CPG.

8. List data users: See item #7 above.

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table.
   Provide an explanation for their exclusion below: N/A

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	5 6 7 8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps	9 9 10 and Introduction Figure 1
2.6 Project Quality Objectives (PQOs) and Measurement Performance Criteria 2.6.1 Development of PQOs Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	14 15 16

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/ SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field QC Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17 Figure 1 18 19 20 Appendix B 21 22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Appendix C 23 24 25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation - Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow - Example Chain-of-Custody Form and Seal	26 Appendix B 27 27 Appendix B
3.4 QC Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples	- QC Samples Table	28

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to QAPP Worksheet No. or Related Documents
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management Procedures	29 30 Data Management Plan (DMP) (AECOM 2010a)
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Planned Project Assessments Table - Assessment Findings and Corrective Action Responses Table	31 32
4.2 QA Management Reports	- QA Management Reports Table	33
4.3 Final Project Report	To be completed following data collection	Not Available (NA)
Data Review		
5.1 Overview 5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step Iia Validation Activities 5.2.2.2 Step Iib Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps Iia and Iib) Process Table - Validation (Steps Iia and Iib) Summary Table - Usability Assessment	34 35 36 37
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	To be completed following data evaluation	NA

QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) Distribution List

The following persons will receive a copy of the approved Final QAPP, subsequent QAPP revisions, addenda, and amendments:

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number*
Jennifer LaPoma	Remedial Project Manager (RPM)	USEPA Region 2	212.637.4328	LaPoma.Jennifer@epa.gov	
William Sy	Project QA Officer	USEPA Region 2	732 321-6648	sy.william@epa.gov	
Robert Law Bill Potter (alternate)	CPG Project Coordinator	de maximis, Inc.	908.735.9315	rlaw@demaximis.com otto@demaximis.com	
John Rolfe	dmi Project Manager (PM)	de maximis, Inc.	908.735.9315	jrolfe@demaximis.com	
William Hyatt	Coordinating Counsel	K&L Gates, LLP	973.848.4045	william.hyatt@klgates.com	
Laura Kelmar	AECOM Project Manager (PM)	AECOM	978.905.2266	Laura.Kelmar@aecom.com	
Ben Bertolotti	AECOM Health and Safety (H&S) Manager	AECOM	973.777.3003	ben.bertolotti@aecom.com	
Doug Simmons	Task Manager (TM)	AECOM	978.905.2401	Doug.Simmons@aecom.com	
Helen Jones	Field Team Manager (FTM)	AECOM	978.905.2248	helen.jones@aecom.com	
Helen Jones	Site Safety Officer (SSO)	AECOM	978.905.2312	helen.jones@aecom.com	
Debra Simmons	Project QA Manager	AECOM	978.905.2399	Debbie.Simmons@aecom.com	
Robert Kennedy	Project Chemist	AECOM	978.905.2269	Robert.Kennedy@aecom.com	
Michael Spera	Project Engineer	AECOM	212.377.8715	Michael.Spera@aecom.com	
James Herberich	Data Management Task Manager	AECOM	978.905.2243	Jim.Herberich@aecom.com	
Waverly Braunstein	Data Validation Coordinator	AECOM	978.905.2133	waverly.braunstein@aecom.com	
Matt Joyce	Survey Manager	Gahagan & Bryant Associates, Inc. (GBA)	410.533.2016	mejoyce@gba-inc.com	
Heather Distel	Laboratory Project Manager	SGS North America Inc. (SGS)	910.794.1613	Heather.Distel@sgs.com	
To Be Determined (TBD)	USEPA Oversight Contractor	CDM Smith	TBD	TBD	

*Uncontrolled electronic copies will be available on www.ourpassaic.org

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization: A completed sign-off sheet will be maintained in the files for each organization represented below.

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read
Robert Law /Bill Potter (alternate)	CPG Project Coordinator	908.735.9315		
John Rolfe	de maximis PM	908.735.9315		
Laura Kelmar	AECOM PM	978.905.2266		
Doug Simmons	AECOM Task Manager	978.905.2401		
Helen Jones	AECOM FTM/SSO	978.905.2248		
Debra Simmons	AECOM Project QA Manager	978.905.2399		
Robert Kennedy	AECOM Project Chemist	978.905.2269		
Michael Spera	AECOM Project Engineer	212.377.8715		
James Herberich	AECOM Data Management Task Manager	978.905.2243		
Waverly Braunstein	AECOM Data Validation Coordinator	978.905.2133		
Matt Joyce	GBA Survey Manager	410.533.2016		
Heather Distel	SGS Laboratory Project Manager	910.794.1613		

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

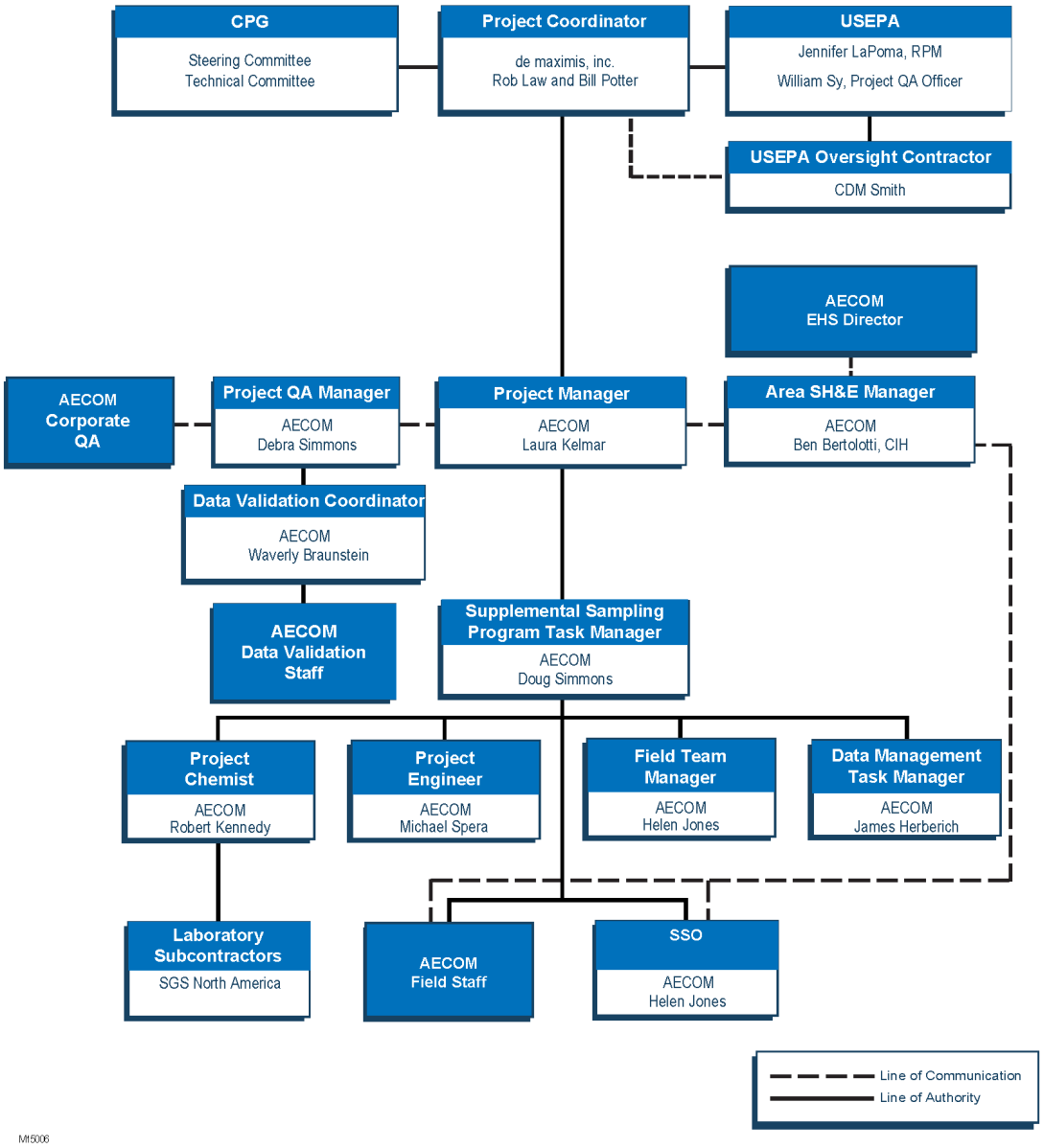
QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization:

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

QAPP Worksheet #5 (UFP-QAPP Manual Section 2.4.1) Project Organization Chart



QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Field activities status and issues	AECOM FTM	Helen Jones	978.905.2248	Communicate daily, or as needed, with AECOM field personnel, subcontractors, and AECOM Task Manager directly, or via e-mail or phone. Minor work plan deviations and/or proposed revisions will be documented and communicated in writing, with a copy sent to USEPA.
Sampling progress/laboratory coordination	AECOM Task Manager	Doug Simmons	978.905.2401 Cell 978.273.4649	Communicate daily, or as needed, with AECOM FTM and Project Chemist via e-mail or phone.
Health and safety briefings and updates	AECOM SSO	Helen Jones	978.905.2248	Communicate daily, or as needed, with field personnel and boat operators directly, or via e-mail or phone.
Significant health and safety concerns or incidents	AECOM SSO	Helen Jones	978.905.2248	Communicate immediately with AECOM Regional H&S Manager, AECOM Task Manager, and AECOM PM.
Analytical laboratory issues, including coordination with field, schedule, and technical issues	AECOM Project Chemist	Robert Kennedy	978.905.2269	Communicate with AECOM FTM and Laboratory PM as needed via phone or e-mail.
Analytical data validation issues	AECOM Data Validation Coordinator	Waverly Braunstein	978.905.2133	Communicate with Laboratory PM as needed via phone or e-mail.
Audit findings (field and/or laboratory)	AECOM Project QA Manager	Debra Simmons	978.905.2399	Communicate findings to AECOM Task Manager or Laboratory PM (as appropriate); transmit final audit reports, including corrective actions (CA), to AECOM PM, AECOM Task Manager, CPG QA Coordinator, USEPA RPM, and United States Army Corps of Engineers (USACE) PM.
Issues potentially affecting	AECOM FTM	Helen Jones	978.905.2248	Communicate as needed with AECOM QA

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
DQOs	AECOM Project Chemist	Robert Kennedy	978.905.2269	Manager and AECOM Task Manager and Engineer via e-mail or phone.
	AECOM Data Validation Coordinator	Waverly Braunstein	978.905.2133	
	AECOM Task Manager	Doug Simmons	978.905.2401 Cell 978.273.4649	Communicate with AECOM QA Manager and AECOM PM as needed, via e-mail or phone. Notification of the CPG Project Coordinator as appropriate. Significant work plan modifications will be reported to USEPA in writing prior to implementation.
	AECOM Project Engineer	Michael Spera	212.377.8715	
Sample collection task implementation, including sampling, analysis, and reporting	AECOM FTM	Helen Jones	978.905.2248	Communicate with AECOM Task Manager as needed, via e-mail or phone.
Project status and issues (internal)	AECOM TM	Doug Simmons	978.905.2401	Communicate with CPG Project Coordinator daily, or as needed, via e-mail or phone, and submit monthly progress reports.
	de maximis PM	John Rolfe	908.735.9315	Communicate with CPG Project Coordinator daily, or as needed, via e-mail or phone, and submit monthly progress reports.
Project status and issues (external)	CPG Project Coordinator	Robert Law/ Bill Potter (alternate) (de maximis, inc.)	908.735.9315	Communicate with USEPA RPM as needed via e-mail or phone.

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
	CPG Coordinating Counsel	William Hyatt / Dawn Monsen (K&L Gates)	973.848.4045 or 4148	In the event the CPG Project Coordinator is unavailable for communication with USEPA, the AECOM PM will notify the Coordinating Counsel prior to contacting USEPA.
Data management	AECOM FTM	Helen Jones	978.905.2248	Communicate with the Data Management Task Manager via e-mail; transmit final field locations and sample collection information daily.
	AECOM Data Management Task Manager	Jim Herberich	978.905.2243	Maintain comprehensive project technical database, communicate with AECOM FTM to receive data from the field; communicate with Laboratory PM(s) to receive analytical result data, communicate with AECOM Data Validation Coordinator to facilitate validation review and database update; communicate with AECOM Task Manager to provide data for review; and provide data deliverables to USEPA.
	GBA Survey Manager	Matt Joyce	410.533.2016	Transmit bathymetry data to TM.
	SGS Laboratory PM	Heather Distel	910.794.1613	Transmit Electronic Data Deliverables (EDDs) to Data Management Task Manager.
Data management (cont.)	AECOM Data Validation Coordinator	Waverly Braunstein	978.905.2133	Communicate with Data Management Task Manager regarding final data qualifiers.

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.4.2) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (timing, pathways, etc.)
Stop Work (technical non-compliance)	AECOM Field team, Project QA Manager, Project Chemist, and Data Management Task Manager			Any personnel believing that a work stoppage is necessary shall first verbally notify the AECOM Task Manager or the AECOM PM, who will in turn verbally notify de maximis, inc. and/or AECOM Project QA Manager, if necessary. Given the potential significance of such communications, this will occur as quickly as possible.

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Robert Law	CPG Project Coordinator (Lead)	de maximis, Inc.	Overall responsibility for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project quality assurance/quality control (QA/QC), and H&S including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the CPG Project Coordinator. Primary point of contact with the USEPA, its oversight contractor and the LPRSA Partner Agencies.	PhD, Geology, 32 years' experience
Willard Potter	CPG Project Coordinator (Alternate)	de maximis, Inc.	Serves as back up for the Lead CPG Project Coordinator. Responsible for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project QA/QC, and H&S including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the CPG Project Coordinator. Primary point of contact with the USEPA, its oversight contractor and the LPRSA Partner Agencies.	BS, Chemical Engineering, 44 years' experience
John Rolfe	de maximis PM	de maximis, Inc.	Responsible for oversight and management of field sampling and construction activities. Also responsible for safe and proper execution of task.	BS Geology, MS Management, 21 years' experience

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Laura Kelmar	AECOM PM	AECOM	Overall responsibility for completion of tasks in accordance with SOW requirements including technical, financial, and scheduling. Primary point of contact for AECOM with CPG Project Coordinator.	BS, Chemical Engineering, MS, Environmental Engineering, 22 years' experience
Doug Simmons	AECOM TM	AECOM	Responsible for the execution and completion of the RM 10.9 long-term monitoring, including procurement of subcontractors, review of task deliverables, and serving as the focus for coordination of all field and laboratory tasks. The AECOM Task Manager will keep the AECOM PM apprised of the status of the task; as well as communicate any issues with the schedule, budget, or achievement of the task objectives.	MS, Geology, 39 years' experience
Helen Jones	FTM	AECOM	Responsible for implementing field sampling activities in accordance with the approved plans (QAPP, Health and Safety Plan [HASP]) and pertinent SOPs. Primary responsibilities will include directing activities on site, monitoring subcontractor performance in the field, reviewing field records, and communicating daily with the AECOM Task Manager regarding status, quality issues, or delays.	MS, Geochemistry, 10 years' experience

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Debra Simmons	Project QA Manager	AECOM	Responsible for reviewing and approving QA procedures, ensuring that planned QA assessments (e.g., technical surveillance audits [TSA], data validation) are conducted according to the QAPP and the AECOM Quality Management Plan (QMP) (AECOM 2009) and reporting on the adequacy of the QA Program to the AECOM PM.	BS, Biology, 35 years' experience
Ben Bertolotti	H&S Manager	AECOM	Responsible for ensuring that the objectives of AECOM's Health and Safety Program are met and for monitoring task activities for conformance to the HASP.	MS, Environmental Sciences/Toxicology, CIH, 24 years' experience
Helen Jones	SSO	AECOM	Responsible for monitoring subcontractor/field team performance in the field and communicating daily with the AECOM FTM, AECOM Task Manager or Regional EHS Manager, as appropriate, regarding health and safety, etc. Will ensure that the objectives of the project's Health and Safety Program are met.	MS, Geochemistry, 10 years' experience
Robert Kennedy	Project Chemist (Lead)	AECOM	Responsible for laboratory procurement and monitoring of progress and will be the primary point of contact with the laboratory(ies). The Project Chemist will also be responsible for communicating any issues that could affect achievement of the DQOs to the AECOM Task Manager and the AECOM Project QA Manager.	BA, Chemistry, 34 years' experience

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Michael Spera	Project Engineer	AECOM	Responsible for providing additional technical resources and serves as a back up to the Task Manager.	ME, Environmental Engineering, BE Civil/Water Resources Engineering, 24 years' experience
Waverly Braunstein	Data Validation Coordinator	AECOM	Responsible for managing the validation task, including ensuring that validation is conducted and documented according to the requirements of this QAPP, and interacting with the laboratory to resolve any issues.	BA, Chemistry, 31 years' experience
James Herberich	Data Management Task Manager	AECOM	Responsible for data management for project, Including overall responsibility for database quality and structure, including graphical representation of data.	BA, Engineering Sciences, 29 years' experience
Matt Joyce	Survey Manager	GBA	Acts as the primary point of contact at GBA for the AECOM TM to communicate and resolve any issues associated with the bathymetry survey.	ME, Aerospace Engineering, 23 years' experience
Heather Distel	Laboratory PM	SGS	Acts as the primary point of contact at SGS for the AECOM Project Chemist to communicate and resolve sampling, receipt, analysis, and storage issues.	PhD , Chemistry, 5 years' experience

QAPP Worksheet #8 (UFP-QAPP Manual Section 2.4.4) Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
FTM	40 hour Hazardous Waste Operations and Emergency Response (HAZWOPER)	QES/Churchill Environmental Inc.	October 2006	Helen Jones	FTM/AECOM	AECOM
	HAZWOPER 8-hr Supervisor	Safety Compliance Management, Inc.	February 2007			
	HAZWOPER 8-hr Refresher	AECOM	Within 12 months (mo)			
	First Aid/ Cardiopulmonary Resuscitation (CPR)	Emergency Care and Safety Institute	Within 24 mo			
SSO	40 hour HAZWOPER	QES/Churchill Environmental Inc.	October 2006	Helen Jones	SSO/AECOM	AECOM
	HAZWOPER 8-hr Supervisor	Safety Compliance Management, Inc.	February 2007			
	HAZWOPER 8-hr Refresher	AECOM	Within 12 mo			
	First Aid/CPR	Emergency Care and Safety Institute	Within 24 mo			
GBA Survey Manager and Boat Captain	U.S. Coast Guard license	U.S. Coast Guard	Various	Various	GBA	GBA

QAPP Worksheet #8 (UFP-QAPP Manual Section 2.4.4) Special Personnel Training Requirements Table

Project Function	Specialized Training by Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
Field Personnel	40 hour HAZWOPER	AECOM	Various	Various	Various/AECOM	AECOM
	HAZWOPER 8-hr Refresher	AECOM	within 12 mo			
	Hazmat awareness	AECOM	Various			

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: RM 10.9 Post-Construction Monitoring **Project Manager: Bill Potter/ Robert Law**	**Site Name: Diamond Alkali OU 2 - LPRRP RI/FS** **Site Location: LPRSA; RM 10.9**
Date of Session: 19 December 2013 **Scoping Session Purpose: Stephanie Vaughn initiated this request for a teleconference to continue an open technical discussion regarding the capping Long-term Monitoring plan for RM 10.9.**	

Name	Affiliation	Phone #	E-mail Address	Project Role
Willard Potter	de maximis, inc.	908.735.9315	otto@demaximis.com	CPG Project Coordinator
Robert Law	de maximis, inc.	908.735.9315	rlaw@demaximis.com	CPG Project Coordinator
Stephanie Vaughn	USEPA	212.637.3914	vaughn.stephanie@epa.gov	EPA Project Manager
Marc Greenberg	USEPA	732.321.6754	greenberg.marc@epa.gov	EPA Senior Technical
Karl Gustavson	USEPA	202.208.3818	gustavson.karl@epa.gov	EPA Senior Technical
Matt Lambert	USEPA	703.603.7174	lambert.matt@epa.gov	EPA Senior Technical
George Hicks	CH2M Hill	812.946.1669	george.hicks@ch2m.com	CPG Technical Consultant
Mike Jury	CH2M Hill	937.220.2961	Mike.jury@ch2m.com	CPG Technical Consultant
Jennifer Wilkie	CH2M Hill	773.458.2830	jennifer.wilkie@ch2m.com	CPG Technical Consultant

Comments/Decisions:

Points of Concern presented by the CPG regarding chemical sampling proposed by USEPA

- What is the intended use for chemical sampling? CPG agrees that physical monitoring is necessary.
- Not clear what the data will be used for, no DQOs identified by USEPA. CPG is concerned with proceeding without a better idea of the use(s) for chemical sampling and especially DQOs.
- Frequency and urgency of USEPA's proposed sampling events (1, 3, and 5 years) is aggressive and premature given the design of the cap and the breakthrough of the COPCs are greater than 100 years.
- Number of sample locations (20 locations, 3 depths) and associated analytical work for multiple parameters maybe too dense; the program outlined by USEPA is expensive.
- Sampling is not trivial, need multiple samplers to accommodate various depth intervals and different chemical types at each location.
- If chemical transport through the cap is the main concern, why not consider monitoring for the most mobile constituent(s) in the sediments (e.g. PAHs), not the "immobile" dioxin or polychlorinated biphenyls (PCBs)?
- CPG is concerned about data being used outside the intended scope.
- CPG is concerned that data could be misinterpreted, e.g., if contaminated sediment from other areas of the river was deposited on top of the cap.

- If chemical monitoring is required by USEPA, consider a phased approach. For example, first look at a smaller subset of sample locations or chemical constituents and, if results indicate a potential issue, then expand the sampling.

USEPA Responses

- Chemical sampling is needed to get a baseline. Baseline would then be used to identify changes in concentration with time.
- Need to collect enough samples to get statistically significant results and overcome bias from sample heterogeneity, which is the basis for the 20 locations.
- Acknowledged and understood our concern about data being used outside the intended scope / DQOs.
- Did not think that a frequency of 1, 3, and 5 years was too much.
- Multiple samplers can be deployed in a single casing, so not really an issue.
- The vertical delineation of chemical concentrations through the cap would help identify the source (i.e., sediments under the cap versus sediment deposited on cap surface from off-site source).
- Would consider the idea of a phased approach with respect to spatial coverage and/or chemicals, but noted that not sampling for the primary COPCs (e.g., PCBs or Dioxins) would be difficult to explain to the public.

Next Steps

- USEPA will look into possibility of developing a preliminary set of DQOs for RM 10.9 for further discussion and basis for CPG developing more complete DQOs.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: RM 10.9 Post-Construction Monitoring **Projected Date(s) of Sampling: 2015** **Project Manager: Bill Potter/ Robert Law**	**Site Name: Diamond Alkali OU 2 - LPRRP RI/FS** **Site Location: LPRSA; RM 10.9**
Date of Session: 19 November 2014 **Scoping Session Purpose: Session #2 on RM 10.9 cap monitoring plan requested by USEPA for CPG to present cap model results and discuss porewater sampling methods**	

Name	Affiliation	Phone #	E-mail Address	Project Role
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* Participated by phone

Comments/Decisions:

- In its October 21, 2014 letter, USEPA requested a meeting for the CPG to "provide predictions of contaminant profile as a function of time, and contaminants along with confidence intervals and a range of input values used to generate the confidence intervals" as well as to discuss porewater sampling methods.
- CPG discussed a number of conservatisms in the CapSim model used in the design of the cap as documented by Danny Reible during his review of the modeling completed by CH2MHill.
- CPG discussed the modeling results that indicated that low levels (femtograms per liter [fg/L] to picogram/liter [pg/L]) were unlikely to be detected in the first 10 years and that break-through was unlikely for decades if not centuries. CPG presented sensitivity results that USEPA had requested. The sensitivity modeling indicated that maximum porewater concentrations, higher Darcy (upwelling) velocities or thinner active layers had little effect on the overall effectiveness of the active layer in the near term with predicted concentrations throughout nearly all of the active layer for all model runs being much less than detection limits.
- USEPA suggested that a rigorous method development process and QA/QC samples were not required since this was a "performance monitoring" program and not a "compliance monitoring" program.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

- CPG stated that any program had to be reliable, reproducible, and defensible and that significant method development is needed to occur since standard sampling methods do not exist.
- USEPA/USACE indicated that passive sampling with SPMEs would be appropriate for the COPCs (2,3,7,8-TCDD, PCBs, and PAHs) with detection limits in the pg/L range and be installed at three depths (underlying sediments, active layer and armor layer). Sampling and analytical methods were discussed. CPG proposed presenting results for the same three COPCs used to design the cap (2,3,7,8-TCDD, PCB-52, and phenanthrene). USEPA indicated that SPME fiber-water partition coefficients are available in the literature for PCBs and PAHs, and they would work with the CPG to select the appropriate values for all COPCs.
- CPG stated that advancing samplers into the near-shore hard-pan areas where little sediment or chemical mass resides is not necessary (and not feasible if SPMEs are to be advanced into underlying sediments as proposed at other locations).
- CPG indicated that USEPA's proposal of dividing the 5-acre capped area into four zones (based on cap conditions such as thickness and environmental/chemical processes that may affect cap performance) with five sample locations per zone (20 samples) was not necessary to evaluate cap performance based on the near-term model predictions and sensitivity analyses which showed that maximum porewater concentrations, higher Darcy (upwelling) velocities or thinner active layers had little effect on the overall effectiveness of the active layer in the near term.
- CPG suggested alternative implementation strategies including fewer locations, active layer-only sampling, a more modest initial effort, fewer events, and that the necessity and frequency of any future sampling be predicated on the results of the initial effort.
- USEPA indicated that the baseline event should also include collection and analysis of surface sediment.
- USEPA/USACE agreed to provide SOPs and QAPPs from other programs and CPG agreed to continue discussions with USEPA.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: RM 10.9 Post-Construction Monitoring **Projected Date(s) of Sampling: 2015** **Project Manager: Bill Potter/ Robert Law**	**Site Name: Diamond Alkali OU 2 - LPRRP RI/FS** **Site Location: LPRSA; RM 10.9**
Date of Session: 1 April 2015 **Scoping Session Purpose: Session #3 on RM 10.9 cap monitoring plan to discuss USEPA comments dated 03/16/2015 on Select QAPP Worksheets submitted on 01/23/2015**	

Name	Affiliation	Phone #	E-mail Address	Project Role
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Comments/Decisions:

A conference call was held to discuss USEPA's comments on the select QAPP worksheets submitted by the CPG, along with the CPG progress on preparing for the RM 10.9 cap monitoring, and the conceptual schedule for implementing the monitoring. The following was discussed:

- The CPG agreed to add the three stations requested by USEPA, for a total of ten stations and to add one sampling round for a total of two sampling rounds (i.e., conduct two chemical sampling rounds and two physical surveys); one at approximately one year and one at approximately five years.
- The objectives of probing were discussed. The CPG discussed that an initial probing event is needed to evaluate the thickness of the cap layers since placement and evaluate how to advance the sampling probes through the armor layer and that probing will also be performed at the time that the SPME samplers are installed. USEPA agreed to this approach and a tentative date for the initial reconnaissance survey of April 20th was suggested due to new moon low tide conditions.
- The USEPA comment (Worksheet 11, DQO 1, Step 4) concerning the statement in the QAPP that changes in the active layer thickness will not trigger additional probing was discussed. The CPG presented that if the armor layer is in place, then any changes in the active layer will be due to consolidation and additional probing would not be needed for this DQO to confirm the physical integrity of the cap. In addition, if what appear to be widespread and significant changes in the thickness of the active layer are found, additional probing may be warranted to determine how widespread the issue is and if it is a potential concern.
- The USEPA comment (Worksheet 11, DQO 1, Step 6) concerning the accuracy of the bathymetry survey was discussed. The CPG discussed that the ± 0.3 meters has been the accuracy for bathymetry surveys used for the project. It was agreed that the bathymetry surveys would

provide gross changes in bathymetry since construction and that the probing will provide the needed accuracy.

- The USEPA comment (Worksheet 11, DQO 2, Step 2) concerning the principal study questions for DQO 2 was discussed. It was agreed that the word "significantly" would be deleted from the first bullet under Alternative Actions and the second bullet under Decision Statements.
- The USEPA comment (Worksheet 11, third bullet on Page 8 of 12) concerning the statement that if COPCs are detected in the cap active layer or armor layer above predicted levels that further evaluation may be required. It was agreed to change may to will.
- The status of the CPG preparation was discussed. It was agreed that only 2,3,7,8-TCDD, PCB-52, and phenanthrene would be reported by the laboratory for all samples and that the laboratory raw data would include all dioxin/furans, PCBs, and PAHs analyzed. The CPG discussed that it planned to deploy the samplers for approximately one month to allow equilibrium and not to include performance reference compounds (PRCs) in the program. USEPA will review this approach.
- The CPG discussed that they have reviewed the literature, identified partitioning coefficients for each analyte, and have calculated estimated sensitivity in porewater. This information will be provided in the QAPP. The CPG discussed that the calculated estimated reporting limits (RLs) are similar to what had been previously discussed (i.e., nanograms per liter [ng/L] to pg/L range). The current estimated reporting limits are: 0.4 pg/L for 2,3,7,8-TCDD, 2.7 pg/L for PCB-52, and 31 ng/L for phenanthrene.
- The schedule going forward was discussed. The CPG discussed that the initial probing event will need to be conducted to finish the QAPP. As described above, a tentative date of April 20th was suggested for the initial reconnaissance. The CPG discussed that approximately two months would be required to complete the QAPP assuming it is agreed that PRCs are not needed. USEPA requested an acceleration of the schedule so that the samplers could be deployed in June or earlier. The CPG discussed that they would consider this schedule, but needed to talk with subcontractors on equipment availability.

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) Problem Definition

The problem to be addressed by the project:

This QAPP for the RM 10.9 Post-Construction Monitoring has been prepared pursuant to the AOC for Removal Action, Docket No. 02-2012-2015 (USEPA, 2012), by the CPG. The RM 10.9 AOC became effective on June 18, 2012. The Removal Action was conducted under CERCLA and the NCP as a TCRA. The Removal Action selected by the USEPA is presented in the Action Memorandum/Enforcement dated May 21, 2012. Cap construction was completed in May 2014. As discussed in the RM 10.9 Removal Action Final Construction Report (CH2MHill, in preparation), the average thicknesses of the active layer and armor layer were 10.5 and 15.2 inches, respectively. In addition, approximately 6 inches of sand was placed on the cap as a habitat layer to fill the voids in the armor stone and to provide a relatively smooth cap surface with a design goal of no net increase in cap elevation above the armor layer. The goals of the removal action were to reduce exposure to elevated concentrations of COPCs in the removal area and to prevent migration of contamination from the removal area to other parts of the river.

The main objective of the RM 10.9 Post-Construction Monitoring is to confirm that the cap is functioning as designed and is therefore, meeting the Removal Action objectives. Those functions require that cap integrity, thickness, and consolidation be checked in response to physical processes such as erosion due to high flows, ice scour, flooding, and human activities. Therefore, the physical monitoring will be performed to ensure that the physical integrity of the armor layer of the cap is maintained such that it continues to protect the active layer. The physical monitoring program described in this QAPP will evaluate the physical integrity of the cap at approximately one year after completion of cap construction. This initial monitoring event will also provide baseline information on cap construction. Data obtained from this physical monitoring program (e.g., bathymetry and probing of cap layer thicknesses) will also be used in the development of the chemical monitoring included in this QAPP.

The chemical monitoring described in this QAPP was directed by USEPA and includes the sampling of porewater at three depth intervals to determine the influence of both underlying sediment concentrations and overlying water concentrations on the cap, as well as to confirm that the cap is performing consistent with the cap model projections and continues to meet the objectives of the removal action. This chemical monitoring will also include collection of sediment samples at the surface of the cap to assess potential recontamination.

The objectives of the RM 10.9 Post-Construction Monitoring are to confirm the physical integrity of the cap and that the chemical isolation layer (i.e., “active layer”) is functioning as designed. These two lines of evidence (physical integrity and chemical isolation) provide direct empirical measurements to validate that the cap is functioning as designed and is therefore sufficient to ensure protection of human health and the environment.

This QAPP includes an initial physical monitoring event approximately one year after cap installation and a baseline chemical monitoring event approximately one year after cap installation (two attempts to complete the first monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction). A similar post-construction monitoring event will be conducted approximately five years after the completion of the removal action. The QAPP will be updated,

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) Problem Definition

as necessary, for this second event based on the results of this initial monitoring event and any advancements in porewater monitoring technology or techniques as long as the modifications allow for comparability with existing data.

This QAPP also includes event-based physical monitoring (e.g., bathymetric survey and poling) that will be performed following river flow events that exceed specified flows or other significant physical disturbances (e.g., adjacent in-river construction activities) that have a high probability of affecting the integrity of the cap.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	Data Quality Objective 1 (DQO 1): Confirm the physical integrity of the cap Description
STEP 1 **State the problem**	Confirmation of the physical integrity of the cap is needed to confirm that the physical properties of the cap are generally consistent with the design. Physical surveys (cap surface elevation and armor layer thicknesses) of the cap will provide the basis to confirm the physical cap integrity. In addition, the potential reduced thickness of the active layer due to consolidation will be evaluated to aid in the design of the porewater sampling program.
STEP 2 **Identify the goals of the study**	**Principal Study Questions** • Is the elevation of the cap surface largely unchanged since the cap was installed? • Is the thickness of the armor layer largely unchanged since the cap was installed? **Program Goals** The goal of this program is to collect physical data that will be compared to the post cap installation data which were collected during cap placement. This comparison will permit assessment of the physical stability of the cap. Data collection will include: • Probing to confirm the thicknesses of the cap armor layer and poling to confirm the presence of the armor layer; although not a goal of the physical monitoring, probing will also establish the thickness of the habitat layer and any recent sediment deposition. • Bathymetric survey to confirm the elevation of the cap surface. **Alternative Actions** The following alternative actions could result from resolution of the principal study questions: • Alternative Action 1: Confirm that the physical properties of the cap (cap surface elevation and armor layer thickness) have remained largely unchanged since construction and therefore no further evaluation is required at this time. • Alternative Action 2: Determine that the physical properties have changed significantly so that further evaluation is needed. **Decision Statements on Physical Integrity of the Cap** • If the thicknesses of the armor layer is largely unchanged, then no additional data are necessary to confirm the physical integrity of the cap. • If the thicknesses of the armor layer is significantly changed, then additional evaluations will be performed to further

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	Data Quality Objective 1 (DQO 1): Confirm the physical integrity of the cap Description
	evaluate the protectiveness of the cap.
STEP 3 **Identify the information inputs**	Information required to answer the decision statement will include the cap installation surveys of the cap layers and data to be obtained from the planned physical surveys (See Step 5 of DQO 1), as summarized below. **New Data Needed** Probing, detailed below in Step 5, will be conducted from the cap surface through the cap layers to the top of the underlying sediment at the ten stations where chemical sampling will be performed (see DQO 2). Poling, detailed below in Step 5, will be conducted from the cap surface or from a boat at transects oriented perpendicular to the shore at the ten stations where chemical sampling will be performed (see DQO 2). A single beam bathymetry survey will be conducted over the RM 10.9 capped area per USACE procedures (USACE, 2013). The bathymetric survey will be conducted with a transect spacing of 25 feet oriented perpendicular to the shore and with three tie-lines running parallel to the shore. **Existing Field Data and Reports (to be Augmented)** Cap installation surveys: • RM 10.9 Removal Action Final Construction Report (CH2M Hill, in preparation)
STEP 4 **Define the boundaries of the study**	**Geographic Area** The RM 10.9 cap is approximate 4.3 acres located approximately between RM 10.75 and RM 11.13 of the Nutley Reach of the LPRSA. The bathymetric survey will be conducted of the cap area and will extend from approximately 100 feet upstream and downstream of the cap and from the shoreline (estimated at the mid tide elevation) to 100 feet from the edge of the cap into the river channel. Probing will be conducted at the ten stations where chemical sampling will be performed (**Figure 1**) and poling will be conducted at transects oriented perpendicular to the shore at the ten stations where chemical sampling will be performed. The presence of any thickness of armor layer would indicate the active layer is in place and differences greater than 50% are being used as a conservative trigger for additional probing. If differences (i.e., greater than 50%) are observed in the armor layer between the thicknesses determined by probing in comparison to the as construction thickness, then additional probing may be performed to confirm the thickness of the armor layer. Changes in the thicknesses of the active layer and habitat layer from post construction, if observed, will be used to aid in the design of the porewater sampling program and will not trigger the requirement for additional probing. This DQO assumes that the armor layer protects the active layer and that if

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	Data Quality Objective 1 (DQO 1): Confirm the physical integrity of the cap Description
	the armor layer is in place, then any change in the thickness of the active layer is due to settlement/consolidation. **Timeframe** Physical data will be collected over an estimated one month period in 2015 for this initial monitoring event. A second event is anticipated to occur approximately 5 years post-construction. Additionally, event-based physical monitoring (e.g., bathymetric survey and poling) will be performed following river flow events that exceed specified flows or other significant physical disturbances (e.g., adjacent in-river construction activities) that have a high probability of affecting the integrity of the cap. A draft report summarizing the results of the physical monitoring will be submitted to USEPA following the completion of the surveys. The bathymetric survey will be performed prior to the chemical sampling (see DQO 2) and will be used to aid in the design of the chemical sampling program. The probing survey will be performed concurrent with the chemical sampling (see DQO 2) and will also be used to aid in the design of the chemical sampling program. **Sample Type** Probes will be advanced to the top of the underlying sediment layer at an estimated depth of 2.5 feet below the top of the cap. Thickness of all layers (habitat, armor, active) will be measured, as feasible. Poling will performed to the top of the armor layer at varying depths related to sediment accumulation. The bathymetric survey will be conducted with a transect spacing of 25 feet oriented perpendicular to the shore with three tie-lines running parallel to the shore.
STEP 5 **Develop the analytical approach**	**Approach for Probing, Poling, and Bathymetric Survey** To minimize disturbance of the cap, probing will initially be attempted by advancing by hand a small-diameter probe. If the probe cannot be advanced by hand, e.g., the armor layer or geotextile layer prevents advancement; an attempt will be made to advance a small-diameter probe with a slide hammer. Poling will utilize a rod to determine the presence of gravel/stone based upon pole refusal on the top of the armor layer. A single beam bathymetric survey will be completed at/near high-tide conditions. Bathymetric surveys will be conducted following USACE procedures (USACE, 2013). The bathymetric survey will be conducted with a transect spacing of 25 feet oriented perpendicular to the shore and with three tie-lines running parallel to the shore. The bathymetric survey will be conducted following procedures consistent with previous surveys. This consistency includes both the survey equipment as well as the methodology for performing the survey. The surveying will be performed in accordance with the USACE Hydrographic Survey Manual, EM 1110-2-1003 (USACE 2013). Single beam data will be collected as the majority of the cap is in areas of shallow water depth where the multi-beam equipment cannot operate.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	Data Quality Objective 1 (DQO 1): Confirm the physical integrity of the cap Description
	Quality Assurance/Quality Control Program (QA/QC) The QA/QC program will be provided in QAPP Worksheets # 21, 22, and 31. **Anticipated Data Evaluations** • The poling data will confirm the presence of the armor layer and the probing data will provide the thickness of the habitat layer and the armor layer. These thicknesses will be compared to as-constructed thickness at the time the cap was installed. • The bathymetric survey will provide the elevations of the cap surface. These elevations will establish a baseline for future surveys. • The physical integrity of the cap will be evaluated based on two decision criteria: armor layer thickness (based on probing) and cap elevation. The cap surface elevation can decrease for two primary reasons: (1) cap erosion and (2) cap consolidation. If the cap surface elevation has dropped, but the armor layer thickness is intact (less than a 50% decrease in comparison to as-constructed cap thickness is being used as a conservative trigger) then the drop in cap elevation is attributed to cap consolidation. Conversely, if the cap surface elevation has dropped and the armor layer thickness has decreased (greater than a 50% decrease in comparison to as-constructed cap thickness is being used as a conservative trigger), then the drop in cap elevation may be attributed, in part, to armor layer erosion. If the armor layer is in place, any change in the thickness of the active layer is due to settlement/consolidation. If the armor layer is not in place, any change in the thickness of the active layer may be attributed, in part, to active layer erosion.
STEP 6 **Specify performance or acceptance criteria**	Uncertainty is always present in the measurement and interpretation of environmental data. In this case, the focus is on collecting and interpreting data on the thickness of RM 10.9 armor layer. In the absence of defined decision tolerance limits, the sampling design should still strive to identify possible sources of error and minimize them, to the extent practical. Both random and systematic errors can be introduced during the physical collection of the data and data handling. Errors introduced through these steps will be controlled by preparing and following SOPs and establishing appropriate controls for data quality. These controls apply to the field procedures (e.g., adherence to SOPs, and field equipment calibration). The QAPP worksheets provide further detail on error control procedures. Field SOPs provide supporting details. For probing, uncertainty is introduced from a number of sources including the accuracy of the depth measurement instrument,

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	Data Quality Objective 1 (DQO 1): Confirm the physical integrity of the cap Description
	the accuracy of the positioning of the probe, and the difficulty of penetrating the cap layers and geotextile layer while minimizing cap disturbance. For poling, uncertainty is introduced from a number of sources, including the ability to feel the armor layer through the overlying sediment, and potential for missing armor stones (i.e., poling between stones) near the edge of the cap. For bathymetric measurements, uncertainty is introduced from a number of sources including the accuracy of the depth measurement instrument, the accuracy of the vessel positioning instrument, the marrying of the position data with depth data, the accuracy of the water level recording instrumentation, and data processing techniques. The depth accuracy of a single beam surface measurement is approximately ±0.15 m (USACE, 2013); therefore all comparisons of measurements between surveys will have total depth uncertainty of approximately ±0.3 m. Thus, all differences of less than approximately 0.3 m will be within the uncertainty band of the single beam survey comparison and cannot be considered a real difference in depth.
STEP 7 **Develop the detailed plan for obtaining data**	**Probing Program** The proposed program will consist of: • 10 probing locations at the locations of the chemistry sampling • One sampling event approximately one year post-construction (up to one month of field work for this initial effort) • One sampling event approximately five years post-construction • Each location will be probed to the top of the underlying sediment at an anticipated depth of 2.5 feet. Other locations may be probed if significant decreases (greater than 50%) are observed in the armor layer between the thicknesses determined by probing in comparison to the as-constructed thicknesses. **Poling Program** • 10 transects oriented perpendicular to the shore at the ten stations where chemical sampling will be performed • On sampling event each year • Each transect will be probed at a number of locations depending on the length of the transect (i.e., the width of the cap at the transect location) • Each location will be probed to the top of the armor layer.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	Data Quality Objective 1 (DQO 1): Confirm the physical integrity of the cap Description
	Bathymetry Survey Following the guidance of the USACE Hydrographic Survey Manual, EM 1110-2-1003, (USACE 2013), a single beam survey will be performed in the area of the RM 10.9 cap and from approximately 100 feet upstream and downstream of the cap and from the shoreline (estimated at the mid tide elevation) to 100 feet from the edge of the cap into the river channel. Single beam survey lines will be spaced at approximately 25 feet and will include approximately 80 transects and with three approximately evenly spaced tie-lines running parallel to the shore. **References** AECOM. 2010b. Lower Passaic River Restoration Project: Periodic Bathymetric Surveys. Quality Assurance Project Plan. Revision 2. AECOM, Westford, MA. May 2010. RM 10.9 Removal Action Final Construction Report (CH2M Hill, in preparation) USACE, 2013. EM 1110-2-1003, Engineering and Design - Hydrographic Surveying.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
STEP 1 **State the problem**	Confirmation of the cap modeling predictions would support the conclusion that the cap is functioning as designed and therefore is meeting its objective of cap protectiveness at this time. Chemical monitoring of in-situ porewater in underlying sediments and the cap layers will provide the basis to confirm the cap model predictions. In-situ porewater will be measured via passive sampling using a solid-phase sorbent from which porewater concentrations will be estimated. In addition, the chemical analysis of surface sediments will be used to evaluate potential recontamination on the cap surface from newly-deposited sediment on top of the engineered cap.
STEP 2 **Identify the goals of the study**	**Principal Study Questions** • What is the concentration of COPCs in the porewater in underlying sediments? • Are COPCs present in the porewater within the cap active layer and cap armor layer? • Are the detected COPC concentrations in porewater consistent with modeling predictions? • Are COPCs present in surface sediments? **Program Goals** This program will measure in-situ porewater concentrations (via passive sampling with sorbents) and will collect surface sediment samples for chemical analysis of select COPCs from representative areas of the RM 10.9 capped area. Specifically, field data will be collected to: • Further assess the concentrations of select COPCs in porewater in underlying sediments. • Assess if select COPCs are present in the porewater within the cap active layer and cap armor layer. • Assess if recontamination of surface sediments is occurring. • Evaluate potential porewater sample impacts from the collection method Data collection will include analysis of: • 2,3,7,8-TCDD • PCB 52

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
	• Phenanthrene **<u>Alternative Actions</u>** The following alternative actions could result from resolution of the principal study questions: • Alternative Action 1: Confirm select COPCs are not present in porewater in the cap active layer and cap armor layer at concentrations above predicted levels which confirms the cap modeling predictions and therefore no further evaluation is required at this time. • Alternative Action 2: If COPCs are present in the porewater within the cap active layer above predicted levels, further evaluations may be required, including evaluating the potential for cross contamination. Similarly, if COCs are detected in the cap active layer or the cap armor layer significantly above predicted levels, the cap modeling predictions may not be confirmed and further data evaluation or data collection will be discussed. • Alternative Action 3: If concentrations in the armor layer are higher than in the active layer it would not be expected to be the result of breakthrough of the active layer, thus further evaluation for assessing the potential for recontamination of the armor layer from overlying surface water or sediment may be required. **<u>Decision Statements on Confirmation of the Cap Modeling Predictions and Cap Long-term Effectiveness</u>** • If COPCs are not detected in the porewater within the cap active layer and the cap armor layer, then the CapSim modeling results are supported at this time. Following the two events during the first five years, USEPA will determine the frequency of further data collection efforts after review of the data obtained as part of this QAPP, and with consideration of the 17-mile RI/FS. • If COPCs are detected in the porewater within the cap active layer or the cap armor layer above predicted levels, then the cap modeling results may not be confirmed and further evaluation or data collection will be required. • If porewater concentrations in the armor layer are higher than in the active layer then it would not be expected to be the result of breakthrough of the active layer, thus further evaluation for assessing the potential for recontamination of the armor layer from overlying surface water or sediment will be required.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
STEP 3 **Identify the information inputs**	Information required to answer the decision statements will include the existing field data and data to be obtained from the planned sampling event (see Step 5 of DQO 2). **New Data Needed** Porewater samples collected using SPME sampling techniques will be collected from the sediments beneath the cap, from the cap active layer and from the cap armor layer. Surface sediment will be collected at the same locations using grab sampling techniques. These porewater and surface sediment samples will be collected from areas representative of cap conditions (see Worksheet #17). Data will be collected approximately one year post-construction (two attempts to complete the first monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction) and five years post-construction. **Existing Field Data (to be Augmented) and Reports** Limited porewater data from underlying sediment from RM 10.9 design (CH2MHill, May 2013).
STEP 4 **Define the boundaries of the study**	**Geographic Area** The RM 10.9 cap is approximately 4.3 acres located approximately between RM 10.75 and RM 11.13 of the Nutley Reach of the LPRSA. Currently, the porewater passive sampler and surface sediment samples will be collected from ten locations spatially distributed across the cap in areas representative of cap conditions that are accessible by walking across the cap (**Figure 5**). **Timeframe** Porewater data will be collected by deploying the passive samplers for a minimum of 60 days. A longer deployment may occur depending on the optimal tides for deployment and retrieval. An initial investigation was scheduled for 2015 (two attempts to complete the first chemical monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction) and a second investigation event is scheduled for 2019, approximately five years post-construction. Surface sediment data will be collected immediately prior to retrieval of SPME samplers used to collect the porewater data for this initial investigation. A draft report will be submitted to USEPA in late 2016. The second draft report will be submitted following the five year post-construction sampling event. The porewater and surface sediment sampling data will be collected following the probing and bathymetric

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
	surveys (DQO 1). **Sample Type** Porewater samples will be collected using SPME fibers. The fibers will be cut from fiber optic cable with a silica core diameter of 200um and a 50um coating of PDMS. Each sampler will consist of 9 fibers of 15 centimeter (cm) length (including portion taped to inner rod) attached to a metal rod in a modified Henry sampler (SOP LPR-S-05). Three separate Henry samplers will be inserted to the appropriate three depths described below at each sample location. Separate samplers will be used to eliminate cross contamination by porewater transport along the sampler shaft. SPME fibers will be exposed to porewater only within the screened interval of the sampler. Surface sediment samples will be collected with a hand auger or stainless steel spoon at stations not covered by water or by push corer or eijkelkamp peat sampler at stations covered by water.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
STEP 5 **Develop the analytical approach**	**<u>Approach for Collecting Porewater Samples</u>** The following procedures will be followed to collect the porewater samples during the initial monitoring event. These procedures may be updated for the second event based on the results of this initial monitoring event and any advancements in porewater monitoring technology or techniques. Porewater samples will be collected through an approximate 5-inch screened interval at three depths: underlying sediments (expected to be approximately 31 to 36 inches below the top of the cap), cap active layer (expected to be approximately 15 to 20 inches below the top of the cap), and armor layer (expected to be approximately 2 to 7 inches below the top of the cap). The top of screened interval of the active layer SPME sampler will be installed immediately (e.g., 1 inch) below the armor layer/geotextile and the top of screened interval of the underlying sediment SPME sampler will be installed at a depth below the geotextile based on the as-constructed thickness of the active layer (approximately 10 inches) plus 6 inches. These depths are approximate[2] and may be adjusted following the probing and bathymetric survey. Porewater samples will be collected using PDMS-coated SPME fibers as passive samplers. SPME fibers will be installed using a modified Henry sampler, or similar device, per SOP LPR-S-05. The samplers will be inserted into the cap in a triangular pattern (one for each of the three depths) as close as possible, and within approximately 2 feet of each other. The precise location of the samplers will depend on the results of the probing and ability to penetrate to the desired depth. It is anticipated that nine SPME fibers of 15 cm length each (including taped portion attached to inner rod) will be installed at each location. The fibers have a silica core diameter of 200um and a 50um coating of PDMS. Following retrieval, they will be cut to a length of 13.3 cm not including the portion of the fibers covered by the PTFE tape (for a total exposed length of 120 cm of SPME fibers [9 × 13.3 cm]). The total volume of exposed PDMS per sample is 47.1 µL.

[2] These depths are based on a cap profile (0 inches sand habitat layer, 0 to 15 inches armor layer, and 15 to 25 inches active layer) assuming the average as-constructed thicknesses of each of the cap layers (0 inches for sand habitat layer, 15 inches for armor layer, and 10.5 inches for active layer, plus 6 inches to ensure the deepest SPME is in the underlying sediment). These depths are approximate and may be adjusted following review of the bathymetric survey results for evidence of consolidation or erosion as confirmed by the probing survey. Any changes to the sampling depths based on these surveys will be provided to Region 2 for review and approval.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
	Approach for Collecting Surface Sediment Samples Surface sediment samples will be collected from the soft sediments deposited on top of the sand habitat layer and will include collection of sediment from the full thickness of the soft sediments above the habitat layer. If soft sediments are not present at a location, or cannot be distinguished from the sand habitat layer, the surface sediment samples will be collected from the sediment surface (approximately 0 to 3 inches) to focus the sampling at the sediment surface where potential newly deposited sediment may be present and not to sample the bottom portion of the clean sand of the habitat layer. These samples will be collected using a hand auger or stainless steel spoon at stations not covered by water or by push corer or eijkelkamp peat sampler at stations covered by water. Sediment samples will be collected from a location as close as possible to the armor layer SPME (outside the area of the 4-inch diameter metal plate used for re-locating the SPME samplers), but not more than 8 inches from the armor layer passive samplers. Samples will be collected immediately prior to the retrieval of the passive samplers. **Anticipated Analytical Methods for Porewater and Surface Sediment Samples** The following lists the analytical methods for all porewater and surface sediment samples: • 2,3,7,8-TCDD using EPA Method 1613B • PCB 52 using EPA Method 1668C • Phenanthrene based on modified California EPA Air Resources Board Method 429 High Resolution Gas Chromatography and High Resolution Mass Spectrometry (HRMS/HRGC) will be used to maximize the analytical sensitivity. **Project Quantification Limits** The reporting limits and estimated detection limits are being evaluated and developed and will be included in QAPP Worksheet #15. **QA/QC Program** The QA/QC program is being developed and will be included in QAPP Worksheet # 12, 20, 24 and 28 in a future revision of this QAPP.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
	<u>Anticipated Data Evaluations</u> • Porewater SPME analytical results will be converted to porewater concentrations using the following published log Kpw values for the PDMS coated SPME fiber/water partition coefficients: Phenanthrene = 3.83 (Ghosh, 2014); PCB-52 = 5.54 (Ghosh, 2014); and 2,3,7,8-TCDD = 5.94 (Cornelissen, 2010). The formula used to calculate porewater results is provided in Worksheet # 37. • Calculated porewater concentrations will be compared between samples at a location (i.e., between sediment beneath the cap, active layer, and armor layer) and between the ten sample locations. The estimated porewater sensitivity, given the PDMS volume from a total of 120 cm exposed fiber length per sampler, will be 31 ng/L for phenanthrene, 2.7 pg/L for PCB-52, and 0.4 pg/L for 2,3,7,8-TCDD. See Worksheet #37 for equations. • Together with the probing and bathymetric results performed in support of DQO 1, the porewater concentration results will be used to confirm the cap modeling predictions. • Surface sediment sample results will be evaluated for indication of recontamination.
STEP 6 **Specify performance or acceptance criteria**	Uncertainty is always present in the measurement and interpretation of environmental data. In this case, the focus is on collecting and interpreting porewater and surface sediment data to confirm the cap modeling predictions. Error targets associated with sampling techniques are not quantifiable. Thus, the sampling design should strive to identify possible sources of error and minimize them, to the extent practical. The most significant type of error that may be encountered includes that of porewater sampling. Both random and systematic errors can be introduced during the physical collection of the sample (e.g., potential cross contamination or fiber disequilibrium with porewater), sample handling (e.g., preparation and handling of SPME fibers), sample analysis (e.g., potential bias in laboratory analysis), and data handling (e.g., uncertainty in the partition coefficient values used to calculate the porewater concentrations). Note the uncertainty associated with phenanthrene and PCB-52 log K_{pw} values is ± 0.05 log units, however the TCDD log K_{pw} has an estimated uncertainty of 0.6 log units. The effect of these uncertainties on the calculated porewater concentrations will be discussed in the final report. Errors introduced through these steps will be controlled by preparing and following SOPs, and establishing appropriate controls for data quality. These controls apply to field procedures (e.g., adherence to SOPs, and field duplicates), laboratory analytical errors (e.g., calibration standard, internal standard, extraction standard recoveries, and laboratory control samples), and data

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
	validation. Sampling design error is the result of the inherent variability of the sampled population over space and time, the sample collection design, and the number of samples available upon which to base the decision. A biased sampling approach was used to select sample locations. As further discussed in Worksheet #17, locations were selected to be spatially distributed across the cap area, and include a location of higher upwelling, locations where sediment samples beneath the cap exhibited relatively higher concentrations of the COPCs compared to other areas of the cap, and locations in areas adjacent to the utility area where a cap was not installed.
STEP 7 **Develop the detailed plan for obtaining data**	**RM 10.9 Porewater and Surface Sediment Sampling and Analysis** The currently proposed sampling program will consist of: • 10 sampling locations • Two sampling events (approximately one year after the completion of the removal action [two attempts to complete the first monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction] and approximately five years after the completion of the removal action.) Porewater data will be collected by deploying the passive samplers for a minimum of 60 days. A longer deployment may occur depending on the optimal tides for deployment and retrieval. • Surface sediment grab samples at each location. • Collection of porewater via passive samplers at three depths: underlying sediment (approximately 31 to 36 inches below the top of the cap), active layer (approximately 15 to 20 inches below the top of the cap), and armor layer (approximately 2 to 7 inches below the top of the cap) using PDMS- coated SPME fibers. These depths are approximate and may be adjusted following the probing and bathymetric survey. • SPME fibers installed using a modified Henry sampler. The samplers will be installed at 10 targeted locations. The samplers will be installed at low tide and will require walking onto the cap. Based on the river water level, some locations may require re-location in the field at the time the samplers are installed. The samplers will be inserted into the cap at each station in a triangular pattern (one for each depth) as close to each other as possible, and within approximately two feet of each other. The precise location of the samplers will depend on the results of the

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQO Step	**Data Quality Objective 2 (DQO 2): Confirm the cap modeling predictions with in-situ porewater monitoring via passive sampling.** **Description**
	probing and ability to penetrate to the desired depth. It is anticipated that nine SPME fibers of 15 cm length each (including taped portion) will be installed at each location. The fibers have a silica core diameter of 200um and a 50um coating of PDMS. Following retrieval, they will be cut to a length of 13.3 cm not including the portion of the fibers covered by the PTFE tape (for a total exposed length of 120 cm of SPME fibers [9 × 13.3 cm]). The total volume of exposed PDMS per sample is 47.1 µL. The surface sediment samples will be collected at the time the SPME samplers are retrieved. These sediment samples will be collected as close as possible to the armor layer SPME (outside the area of the 4-inch diameter metal plate used for re-locating the SPME samplers), but no more than 8 inches from the armor layer SPME location. Samples of sediment and the SPME fibers will be analyzed for 2,3,7,8-TCDD, phenanthrene, and PCB-52 as described in Step 5 above. **References** River Mile 10.9 Removal Action Final Design Report, Lower Passaic River Study Area (CH2MHill May 2013)

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	SPME fibers and sediment				
Analyte	Phenanthrene				
Concentration Level	Low				
Sampling Procedure[a]	**Analytical Method/SOP[b]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria (MPC)[c]**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-S-01, LPR-S-05	AP-2	Accuracy/Bias-Contamination	No target compounds >Quantitation Limit (QL)	Method Blank (MB)	A
	AP-2	Accuracy/Bias-Contamination	No target compounds >QL	Equipment Rinsate Blanks for sediment	S&A
	AP-2	Accuracy/Bias-Contamination	No target compounds >QL	Field Blanks for SPME fibers	S&A
	AP-2	Accuracy/Bias	Native compound %difference (%D) (vs. Initial Calibration (ICAL)) ≤ 30%; Labeled Standard %D (vs. ICAL) ≤ 50%; Native Compound Relative Percent Difference (RPDs) ≤ 10%; Labeled Standard RPDs ≤ 20%	Batch Control Spike (BCS)	A
	AP-2	Accuracy/Bias	40-150%Recovery (%R)	Pre-extraction Internal Standards	A
	AP-2	Precision	RPD ≤ 50% if both samples are > 5x QL	Field Duplicate	S&A
	AP-2	Completeness	≥ 90%	Data Completeness Check	S&A

[a] Refer to QAPP Worksheet #21
[b] Refer to QAPP Worksheet #23
[c] Full method QC elements may be reviewed however only elements associated with the single target analyte specified in Worksheet #15 are relevant.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	SPME fibers and sediment				
Analyte	PCB-52				
Concentration Level	Low				
Sampling Procedure[a]	**Analytical Method/SOP[b]**	**DQIs**	**MPC[c]**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-S-01, LPR-S-05	AP-3	Accuracy/Bias-Contamination	No target compounds >1/10 concentration in associated samples	MB/Instrument Blank	A
	AP-3	Accuracy/Bias-Contamination	No target compounds >1/10 concentration in associated samples	Equipment Rinsate Blanks	S&A
	AP-3	Accuracy/Bias-Contamination	No target compounds >1/10 concentration in associated samples	Field Blanks for SPME fibers	S&A
	AP-3	Accuracy/Bias	Native compounds by isotope dilution %D vs ICAL ≤ 20%; Labeled standard %D vs ICAL ≤ 30%; Native Compound RPDs ≤ 10% for isotope dilution	BCS	A

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Sampling Procedure[a]	Analytical Method/SOP[b]	DQIs	MPC[c]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
LPR-S-01, LPR-S-05 (cont.)	AP-3	Accuracy/Bias	Per EPA Method 1668C Table 6	Pre-extraction Internal Standards	A
	AP-3	Precision	RPD ≤ 50% if both samples are > 5x EML	Field Duplicate	S&A
	AP-3	Completeness	≥ 90%	Data Completeness Check	S&A

[a] Refer to QAPP Worksheet #21
[b] Refer to QAPP Worksheet #23
[c] Full method QC elements may be reviewed however only elements associated with the single target analyte specified in Worksheet #15 are relevant.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	SPME fibers and sediment				
Analyte	2,3,7,8-TCDD				
Concentration Level	Low				
Sampling Procedure[a]	**Analytical Method/SOP[b]**	**DQIs**	**Measurement Performance Criteria[c]**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
LPR-S-01, LPR-S-05	AP-1	Accuracy/Bias-Contamination	a) No Target Compound exceeding the adjusted QL b)If detected, the concentration should be less than the QL or <10 times the highest concentration found in the sample batch; c) signal to noise should be >10:1 for isotopically labeled standard added before extraction	MB	A
	AP-1	Accuracy/Bias-Contamination	No target compound >QL	Equipment Rinsate Blanks	S&A
	AP-1	Accuracy/Bias-Contamination	No target compound >QL	Field Blanks for SPME fibers	S&A
	AP-1	Accuracy/Bias	Native compound %D (vs. ICAL) ≤ 20%; Labeled Standard %D (vs. ICAL) ≤ 30%; Native Compound RPDs ≤ 10%; Labeled Standard RPDs ≤ 20%	BCS	A

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Sampling Procedure[a]	Analytical Method/SOP[b]	DQIs	MPC[c]	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
LPR-S-01, LPR-S-05 (cont.)	AP-1	Accuracy/Bias	Within statistical control limits	QC Standard	A
	AP-1	Precision	RPD ≤ 50% if both samples are > 5x QL	Field Duplicate	S&A
	AP-1	Completeness	≥ 90%	Data Completeness Check	S&A

[a] Refer to QAPP Worksheet #21
[b] Refer to QAPP Worksheet #23
[c] Full method QC elements may be reviewed however only elements associated with the single target analyte specified in Worksheet #15 are relevant.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by USEPA/MPI or other agencies on the Passaic River				
Probing and core data from pre-coring reconnaissance work	USEPA sampling program conducted by MPI in 2007-08	USEPA. Inference on sediment type and thickness (probing) as well as sediment description (cores)	Recent surficial sediment conditions.	Subjective delineation and identification method subject to different interpretations. Comparison of core logs and these data required to verify results.
Analytical data from the Lower Passaic River (LPR) High Resolution Coring program	USEPA sampling program conducted by MPI in 2005	USEPA. Sediment dating (Cesium [Cs}-137, Beryllium-7 [Be-7]) and contaminant concentrations (Polychlorinated Dibenzodioxins / Polychlorinated Dibenzofurans [PCDDs/PCDFs], PCBs, PAHs, pesticides, metals). Cores collected Sept. 19 to Oct. 12, 2005.	Map aerial and vertical chemical distribution	Only 5 sediment cores were analyzed for limited and selected chemical parameters. 14 analyzed for Cs-137 over a 10 mile interval. Not all segments from all cores were analyzed. Core in erosional areas were either not utilized or not fully analyzed. Several cores did not produce recovery called for in SOPs. Summary narrative provided. Characterization report not produced to document field or analytical activities. Use data with the recognition that laboratory and/or validation qualifiers may impose limitations on specific datasets and/or data points.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Analytical data from grab samples and sediment cores	USEPA Empirical Mass Balance Model (EMBM) Sampling Program, conducted Dec 2007 – Feb 2008	USEPA. Sediment cores and grabs analyzed for organic and inorganic contaminants	Evaluation of various organic and inorganic chemicals	Samples collected using vibracoring should be interpreted noting individual core recovery and the uncertainty of vertical placement of the recovered samples. Use data with the recognition that laboratory and/or validation qualifiers may impose limitations on specific datasets and/or data points.
Analytical data from the grab samples collected for sediment dating	USEPA sampling program conducted by MPI in 2005	USEPA (collected by MPI) - Aug 2005 - 45 locations - Be-7	Provide insight into potential deposition areas	Characterization report not produced to document field or analytical activities. Use data with the recognition that laboratory and/or validation qualifiers may impose limitations on specific datasets and/or data points.
Work Performed by Tierra Solutions, Inc. on the Passaic River				
Analytical data from the LPR coring program	Tierra Solutions, Inc. Newark Bay Study Area RI Work Plan	Tierra Solutions Inc. Sediment chemistry collected from 93 sediment core locations (658 samples) for chemical, radiological and geotechnical analysis.	Evaluation of various organic and inorganic chemicals	Samples collected using vibracoring should be interpreted noting individual core recovery and the uncertainty of vertical placement of the recovered samples. Use data with the recognition that laboratory and/or validation qualifiers may impose limitations on specific datasets and/or data points.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by CPG/AECOM on the Passaic River				
Aerial Photography and Digital Orthophotos, photogrammetric mapping and topography	CPG, LPRSA.	Produced by GEOD Corp on behalf of CPG. Data sent to USEPA in November and December 2007.	In completion of RI/FS. Data also used in design of RM 10.9 removal action	Orthophotos - Valid for accuracy and map scales as explained in the metadata. Current only as of the date of photography, 3/12/2007 Photogrammetric Mapping Products - Valid for accuracy and map scales as explained in the metadata. Current only as of the date of photography, 4/11/2007.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Bathymetric surveys	CPG August – September 2007 Bathymetry Survey, June 2010 Multibeam Survey, April 2011 Multibeam Survey, October – November 2011 Multibeam Survey, Multibeam and Single-Beam Survey, August – September 2012.	CPG. Multi-beam and single beam survey performed by GBA (subcontractor to ENSR) in Aug-Sept 2007 and Aug-Sept, 2012; Multibeam surveys performed by GBA (subcontractor to AECOM) in November 2008, June 2010, and October – November 2011.	Characterize existing bathymetry, compare with previous surveys to assess sediment stability. Data also used in design of RM 10.9 removal action	Single beam – 2007 coverage limited to project RM 0.5 - 8.2 and 14.3 - 16.5. Current only as of the date of survey, August 2007. 2012 coverage limited to project RM 0 - 0.9, RM 1.8 - 3.05, RM 3.5 - 4.2, RM 6.6 - 7.1, RM 7.1 - 7.5 RM 7.5 - 7.8 RM 9.6 - 10.2, RM 10.5 – 11, RM 11.20 and Third River. Current only as of the data of survey, August – September 2012. Multi-beam coverage limited to RM 0 - 14.4, and to channel area in RM 0 - 0.9. Current only as of the date of survey, August 2007, November 2008, June 2010, October – November 2011, and August – September 2012. Multi-beam coverage limited to RM 0 - 14.4, and to channel area in RM 0 - 0.9. Limited to water depth of -6 feet National Geodetic Vertical Datum (NGVD). Current only as of the date of surveys.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Analytical data from the LPR low resolution coring program (LRC) and LRC supplemental sediment sampling (SSP) and second SSP (SSP2) coring program	Draft reports to USEPA: 2/28/2010 (LRC) December 2013 (LRC SSP) October 2014 (LRC SSP2)	CPG. Sediment chemistry collected from 110 (LRC), 85 (LRC SSP) and 78 (LRC SSP2) sediment core locations and co-located grab locations for chemical, radiological and geotechnical analysis.	Evaluation of various organic, inorganic chemicals, radiochemistry, and geotechnical data. Data also used in design of RM 10.9 removal action	Samples collected using vibracoring should be interpreted noting individual core recovery and the uncertainty of vertical placement of the recovered samples. Use data with the recognition that laboratory and/or validation qualifiers may impose limitations on specific datasets and/or data points.
Work Performed by CPG/Windward on the Passaic River				
Analytical sediment data from the LPR benthic program	No report to date	CPG. Sediment chemistry collected from 116 grab locations for chemical analysis.	Evaluation of various organic and inorganic chemicals	Use data with the recognition that laboratory and/or validation qualifiers may impose limitations on specific datasets and/or data points.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Work Performed by CPG/CH2M Hill on the Passaic River				
Porewater extracted from sediment cores	RM 10.9 Removal Action Final Design Report, CH2MHill, May 2013	CPG. Porewater generated from site sediment was analyzed for select COPCs. Sediment cores were collected in February 2013 from within the Removal Area to obtain sediment representing the material remaining after dredging (i.e., from 2 to 4 feet below the mud line). Core locations were targeted to generate porewater with the highest COPC concentrations as determined from sediment concentrations measured during the 2011 RM 10.9 Characterization Program. The cores were sent intact to the laboratory for extraction of porewater via centrifugation and subsequent analysis of PCDDs/PCDFs , PCBs, PAHs, and mercury.	Input to CapSim model for cap design (i.e., cap thickness and carbon dosage).	Porewater concentrations are biased high as porewater composite samples were generated from sediment cores collected from locations with the 10 highest sediment concentrations of PCDDs/PCDFs, PCBs, and mercury within the 2 to 4 feet depth interval (below the sediment cap). In addition, porewater generated from centrifuging sediments likely resulted in over-estimating the truly dissolved concentrations of the hydrophobic contaminants.

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Groundwater seepage velocities	RM 10.9 Removal Action Final Design Report, CH2MHill, May 2013 and Lower Passaic River Seepage Survey Draft Data Report, Coastal Monitoring Associates, LLC, April 2013	CPG. Direct measurements of groundwater flux through the sediments in the RM 10.9 Removal Area were obtained in April 2013 through the temporary installation of ultrasonic seepage (UltraSeep) meters. UltraSeep meters perform time series flow rate measurements, which capture both positive and negative discharge at the surface water-sediment interface. The UltraSeep meters were installed at four monitoring locations (along the -4 feet elevation contour) and continuously monitored seepage velocity for approximately 3 days.	Input to CapSim model for cap design.	None noted by data originator.
Thickness and water depths of cap layers; samples of cap materials	River Mile 10.9 Removal Action Final Construction Report, CH2MHill, in preparation	CPG. Cores, surveys, and material ratio tests (MRTs) conducted by CH2MHill and Great Lakes Dredge and Dock (GLDD).	Document that the cap was constructed as per the final design (i.e., layer thicknesses and AquaGate percentages [carbon dosages])	None noted by data originator.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Probing survey: Probing will be conducted at the ten stations where chemical sampling will be performed (**Figure 1**). Probing will be advanced to confirm the depths to and thickness of each cap layer (habitat layer, armor layer and active layer) and the depth to sediments beneath the cap, where possible (based on the results of preliminary probing conducted on April 20 and 21, 2015 [as discussed in the May 4, 2015 Field Activity Results Summary, LPR River Mile 10.9 Initial Reconnaissance], probing will not be able to distinguish between the active layer and the underlying sediments). For confirmation of the physical stability of the cap, additional probing may be performed if significant decreases (greater than 50%) in the thickness of the armor layer (as compared to the construction thickness) are observed. Probing will be performed using a drive point probe (AMS Soil Vapor Probe) advanced with a slide hammer.

Probing will be conducted concurrent with chemical sampling events.

Poling survey: Poling will be conducted along ten transects oriented perpendicular to the shore through the ten chemical sampling station. Poling will be conducted to confirm the presence of the armor layer. Poling will be performed using a solid rod or pipe pushed by hand through the overlying accumulated sediment and habitat layer.

Poling will be conducted at the frequency described in the RM 10.9 LTMMP (AECOM, 2017).

Bathymetry survey: A single beam bathymetry survey will be performed to measure the elevation of the top of the cap. The survey will be performed over the area of the cap plus 100 feet upstream and downstream of the cap from the shoreline (estimated at the mid tide elevation) to 100 feet from the edge of the cap into the river channel (**Figure 1**). The bathymetric survey will be conducted following USACE procedures (USACE, 2013). Single beam survey lines will be spaced at approximately 25 feet and with three tie-lines running parallel to the shore. The single beam survey will include approximately 80 transects.

Two bathymetry surveys will be performed. The first will occur approximately one year post-construction and the second at approximately five years post-construction. Event-based physical monitoring (e.g., bathymetric survey and poling) will also be performed following river flow events that exceed specified flows or other significant physical disturbances (e.g., adjacent in-river construction activities) that have a high probability of affecting the integrity of the cap.

Sampler and Laboratory Techniques Development: Superguide Polymer Clad Silica (SPC200/300R) optic fiber was selected for the SPME samplers. This fiber has a silica core outer diameter (OD) of 200±4 um and a PDMS cladding of 50um, which yields a total OD of 300 ± 6um. A total of 120 cm of exposed fiber will be used for each sampler attached to a metal rod inside the modified Henry sampler. Given the thin polymer coating and that complete equilibration within 28 days has been demonstrated by PRCs for TCDD used in previous SPME studies at other sites, a decision was made to deploy the samplers for a minimum of 60 days and not include PRCs. No laboratory method development is needed because the SGS-

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Wilmington, NC laboratory has already successfully extracted SPME fibers for PCDDs/PCDFs, PCBs, and PAHs in previous projects. SPME-PDMS partitioning coefficients were obtained from literature sources and are provided in Worksheet #11.

Field Techniques Development: Methods to install the SPME fibers to the required depth without cross contamination while minimizing the disturbance of the cap required evaluation. Field trials of installation techniques were conducted concurrent with the probing activities on April 20 and 21, 2015. Based on the results of these field trials, discussed in the May 4, 2015 Field Activity Results Summary, LPR River Mile 10.9 Initial Reconnaissance, the following conclusions were made concerning the upcoming SPME sampling:

1 Because of difficulties with driving the sampler through the armor layer, installing the samplers by hand with direct walking access to the RM 10.9 cap is the preferred method of installing the samplers. It does not appear that divers would be an effective method of installing the samplers.

   If the samplers are installed by directly walking on the RM 10.9 cap, some adjustment to the sampling locations will likely be required (i.e., moved towards the shore in the event the station is submerged during low tide, adjustments due to large armor stone present, etc.). Additionally, stations 0609 and 0610 may need to be relocated farther downstream to an accessible area of the RM 10.9 cap or a small boat may be needed to access these locations. Close and constant coordination between the CPG and USEPA will be maintained during field activities. This coordination will help to ensure that any proposed major deviations from the work plan, including changes in sample location, can be reviewed by USEPA and, if acceptable, approved in “real time” prior to implementation.

2 The probing method used did not distinguish between the active layer of the cap and the underlying sediments. The probing method did distinguish between the armor layer and underlying geotextile and the active layer.

   The active layer SPME sampler could be installed immediately (e.g., 1 inch) below the armor layer/ geotextile and the underlying sediment SPME sampler could be installed at a depth below the geotextile based on the as-constructed thickness of the active layer plus 6 inches.

Sampling Tasks: Porewater samples will be collected at ten locations (see **Figure 1**). The sampling techniques for the SPME samplers assume the ability to walk to each location. Sampling will occur, therefore, at low tides and during a period of low river stage. Some locations may not be accessible at the time of sampling and may need to be modified at the time of sampler placement. Close and constant coordination between the CPG and USEPA will be maintained during field activities. This coordination will help to ensure that any proposed major deviations from the work plan, including changes in sample location, can be reviewed by USEPA and, if acceptable, approved in “real time” prior to implementation.

Samples will be collected through an approximate 5-inch screened interval from three depths: underlying sediment (approximately 31 to 36 inches), cap active layer (approximately 15 to 20 inches), and cap armor layer (approximately 2 to 7 inches). The top of screened interval of the active layer

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

SPME sampler will be installed immediately (e.g., 1 inch) below the armor layer/geotextile and the top of screened interval of the underlying sediment SPME sampler will be installed at a depth below the geotextile based on the as-constructed thickness of the active layer (approximately 10 inches) plus 6 inches. These depths are approximate and may be adjusted following review of the bathymetric survey results for evidence of consolidation or erosion as confirmed by the probing survey. Any changes to the sampling depths based on these surveys will be provided to Region 2 for review and approval. Porewater analyses will be conducted using PDMS-coated SPME fibers as passive samplers. The SPME fibers will be installed using a sacrificial AMS Soil Vapor Probe Drive Point to advance through the armor layer and geotextile fabric and a Henry Push Point Sampler to install the SPME fibers into the drive point. Three samplers will be installed per location; one at each target depth. The samplers will be set in a triangular pattern.

Surface sediment samples will be collected at the same ten locations as the porewater samples. Surface sediment samples will be collected from the soft sediments deposited on top of the sand habitat layer and will include collection of sediment from the full thickness of the soft sediments above the habitat layer. If soft sediments are not present at a location, or cannot be distinguished from the sand habitat layer, the surface sediment samples will be collected from the sediment surface (approximately 0 to 3 inches) to focus the sampling at the sediment surface where potential newly deposited sediment may be present and not to sample the bottom portion of the clean sand of the habitat layer. These sediment samples will be collected as close as possible to the armor layer SPME (outside the area of the 4-inch diameter metal plate used for re-locating the SPME samplers), but no more than 8 inches from the armor layer SPME location. Surface sediment samples will be collected using a hand auger or stainless steel spoon at stations not covered by water or by push corer or eijkelkamp peat sampler at stations covered by water.. Samples will be collected immediately prior to the retrieval of SPME fibers.

Two sampling events will be conducted. The first will occur approximately one year post-construction (two attempts to complete the first monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction) and the second at approximately five years post-construction.

Analysis Tasks: Porewater and surface sediments will be analyzed for the following parameters:

- 2,3,7,8-TCDD by EPA Method 1613B
- PCB-52 by EPA Method 1668C
- Phenanthrene by modified California EPA Air Resources Board Method 429

Quality Control Tasks: QC samples have been defined for the field and laboratory efforts. Field QC samples are summarized on Worksheet #20; laboratory QC samples are summarized on Worksheet #28.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Secondary Data: All relevant secondary/historical data are summarized on Worksheet #13.

Data Management Tasks: AECOM's DMP (AECOM 2010a) covers all field-collected and laboratory-generated records/data. The handling of records and data will be summarized on Worksheet #29.

Documentation and Records: Project related records (field, sample transfer/chain of custody, laboratory) will be summarized on Worksheet #29.

Assessment/Audit Tasks: Field and laboratory audits will be scheduled in accordance with Worksheet #31.

Data Review Tasks: Field data will be reviewed as will be described in Worksheet #34. Laboratories are contractually required to verify all laboratory data including EDDs as will be summarized in Worksheet #34. Data validation and usability assessments will be conducted as will be detailed in Worksheets #35, 36, and 37.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels Reference Limits and Analytical Method Evaluation Table

Matrix: SPME Fibers
Analytical Group: PCBs – Congeners**;** EPA Method 1668C; SGS - Wilmington, NC
Concentration Level: Low

Analyte	Chemical Abstract Service Number (CAS Number)	Project Action Level (PAL) (pg/sample)[a]	Project QL Goal (pg/sample)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				Method Detection Limits (MDLs) (pg/g)	Method EMLs (pg/g)	EDLs (pg/sample)	EMLs (pg/sample)
PCB 52	35693-99-3	180	180	15	50	45	180

[a] PALs based on QLs derived from the low point of calibration or 4x the average Estimated Detection Limit (EDL), whichever is greater. Note PALs are not risk based for this program but are equivalent to the QL/EMLs because laboratory results are reported on a pg/sample basis.

[b] Analytical MDLs and EMLs are those documented in validated methods, modified for a 1 gram (g) sample size.

[c] Achievable EDLs (derived from annual averaged field sample and QC sample EDLs) and QL or EMLs are limits that an individual laboratory can achieve when performing a specific analytical method and are typically based on whole samples as received. Actual EDLs and QL or EMLs will vary based on sample-specific factors. All results between the EDL and QL or EML will be reported as estimated values (J qualifier). RLs (i.e., the numerical values associated with non-detects) for the individual congeners will be based on sample-specific EDLs rather than QL or EMLs. Laboratory results will be reported in pg/sample, rather than pg/g. The final multi-media electronic data deliverable (MEDD) will contain both the laboratory reported values (pg/sample) and values converted to pg/L for dissolved phase porewater. Matrix interference can increase EDLs by as much as a factor of 10-fold, but common laboratory contaminants are not expected to significantly impact the laboratory sensitivity goals.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels Reference Limits and Analytical Method Evaluation Table

Matrix: SPME Fibers
Analytical Group: PCDDs/PCDFs; EPA Method 1613B; SGS - Wilmington, NC
Concentration Level: Low

Analyte	CAS Number	PAL (pg/sample)[a]	Project QL Goal (pg/sample)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDLs (pg/g)	Method EMLs (pg/g)	EDLs (pg/sample)	EMLs (pg/sample)
2,3,7,8-TCDD	1746-01-6	70	70	NA	10	17	70

[a] PALs based on laboratory QLs derived from the low point of calibration or 4x the average EDL, whichever is higher. Note PALs are not risk based for this program but are equivalent to the QL/EMLs because laboratory results are reported on a pg/sample basis.

[b] Analytical MDLs and QLs are those documented in validated methods, modified for a 1 g sample size.

[c] Achievable EDLs (based on annual laboratory averaged EDLs including both field and lab QC samples) and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual EDLs and QLs will vary based on sample-specific factors. All results between the EDL and QL will be reported as estimated values (J qualifier). Laboratory results will be reported in pg/sample, rather than pg/g. The final MEDD will contain both the laboratory reported values (pg/sample) and values converted to pg/L for dissolved phase porewater. The laboratory RL (i.e., the numerical value associated with a non-detect) will be based on the sample-specific EDL. Matrix interference can increase EDLs by as much as a factor of 10x, but common laboratory contaminants are not expected to significantly impact the laboratory sensitivity goals

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels Reference Limits and Analytical Method Evaluation Table

Matrix: SPME Fibers
Analytical Group: PAHs, SOP AP-CM-4, based on California EPA Air Resources Board Method 429, SGS - Wilmington, NC
Concentration Level: Low

Analyte	CAS Number	PAL (pg/sample)[a]	Project QL Goal (pg/sample)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDL (pg/g)	Method PQL (pg/sample)	EDL (pg/sample)	QL (pg/sample)
Phenanthrene	85-01-8	40000	40000	NA	22000	9900	40000

[a] PALs based on laboratory QLs derived from the low point of calibration or 4x the average EDL, whichever is higher. Note PALs are not risk based for this program but are equivalent to the QL/EMLs because laboratory results are reported on a pg/sample basis.

[b] Analytical MDLs and QLs are those documented in validated methods, modified for a 1 g sample size. "NA" indicates that MDL and/or QL values were not included in the validated methods.

[c] Achievable EDLs (based on annual laboratory averaged EDLs including both field and lab QC samples) and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual EDLs and QLs will vary based on sample-specific factors. All results between the EDL and QL will be reported as estimated values (J qualifier). Laboratory results will be reported in pg/sample, rather than pg/g.. The final MEDD will contain both the laboratory reported values (pg/sample) and values converted to pg/L for dissolved phase porewater. The laboratory RL (i.e., the numerical value associated with a non-detect) will be based on the sample-specific EDL. Matrix interference can increase EDLs by as much as a factor of 10x, but common laboratory contaminants are not expected to significantly impact the laboratory sensitivity goals

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels Reference Limits and Analytical Method Evaluation Table

Matrix: Sediment
Analytical Group: PCBs – Congeners**;** Method 1668C; SGS, Wilmington, NC
Concentration Level: Low

				Analytical Method[b]		Achievable Laboratory Limits[c]	
Analyte	**CAS Number**	**PAL (pg/g)[a]**	**Project QL Goal (pg/g)**	**Method Detection Limits (MDLs) (pg/g)**	**Method EMLs (pg/g)**	**EDLs (pg/g)**	**EMLs (pg/g)**
PCB 52	35693-99-3	5	5	1.5	5	2.2	5

[a] PALs based on QLs derived from the low point of calibration or laboratory EMLs if the EML is elevated above the QL. Most laboratory EMLs are equivalent to the QLs. Note PALs are not risk based for this program but are equivalent to the QL/EMLs because laboratory results are reported on a pg/sample basis.

[b] Analytical MDLs and EMLs are those documented in validated methods, assuming a 10 gram (g) dry weight sample size.

[c] Achievable EDLs (derived from annual averaged field sample and QC sample EDLs) and QL or EMLs are limits that an individual laboratory can achieve when performing a specific analytical method and are typically based on whole samples as received. Actual EDLs and QL or EMLs will vary based on sample-specific factors. All results between the EDL and QL or EML will be reported as estimated values (J qualifier). RLs (i.e., the numerical values associated with non-detects) for the individual congeners will be based on sample-specific EDLs rather than QL or EMLs. Matrix interference can increase EDLs by as much as a factor of 10-fold, but common laboratory contaminants are not expected to significantly impact the laboratory sensitivity goals.

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels Reference Limits and Analytical Method Evaluation Table

Matrix: Sediment
Analytical Group: PCDD/PCDFs; Method 1613B; SGS, Wilmington, NC
Concentration Level: Low

Analyte	CAS Number	PAL (pg/g)[a]	Project QL Goal (pg/g)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDLs (pg/g)	Method EMLs (pg/g)	EDLs (pg/g)	EMLs (pg/g)
2,3,7,8-TCDD	1746-01-6	1	1	NA	1	0.3	1

[a] PALs based on laboratory QLs derived from the low point of calibration. Note PALs are not risk based for this program.

[b] Analytical MDLs and QLs are those documented in validated methods, assuming a 10 g dry weight sample size. "NA" indicates that MDL and/or QL values were not included in the validated methods.

[c] Achievable EDLs (based on annual laboratory averaged EDLs including both field and lab QC samples) and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual EDLs and QLs will vary based on sample-specific factors. All results between the EDL and QL will be reported as estimated values (J qualifier). The laboratory RL (i.e., the numerical value associated with a non-detect) will be based on the sample-specific EDL. Matrix interference can increase EDLs by as much as a factor of 10x, but common laboratory contaminants are not expected to significantly impact the laboratory sensitivity goals

QAPP Worksheet #15 (UFP-QAPP Manual Section 2.8.1) Data Quality Levels Reference Limits and Analytical Method Evaluation Table

Matrix: Sediment
Analytical Group: PAHs, SOP AP-CM-4, based on California EPA Air Resources Board Method 429, SGS, Wilmington, NC
Concentration Level: Low

Analyte	CAS Number	PAL (pg/g)[a]	Project QL Goal (pg/g)	Analytical Method[b]		Achievable Laboratory Limits[c]	
				MDLs (pg/g)	Method QLs (pg/g)	EDLs (pg/g)	QLs (pg/g)
Phenanthrene	85-01-8	4000	4000	NA	2200	990	4000

[a] PALs based on laboratory QLs derived from the low point of calibration or 4x the average EDL, whichever is greater. Note PALs are not risk based for this program.

[b] Analytical MDLs and QLs are those documented in validated methods, assuming a 10 g dry weight sample size. "NA" indicates that MDL and/or QL values were not included in the validated methods.

[c] Achievable EDLs (based on annual laboratory averaged EDLs including both field and lab QC samples) and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. Actual EDLs and QLs will vary based on sample-specific factors. All results between the EDL and QL will be reported as estimated values (J qualifier). The laboratory RL (i.e., the numerical value associated with a non-detect) will be based on the sample-specific EDL. Matrix interference can increase EDLs by as much as a factor of 10x, but common laboratory contaminants are not expected to significantly impact the laboratory sensitivity goals

QAPP Worksheet #16 (UFP-QAPP Manual Section 2.8.2) Project Schedule/Timeline Table[1]

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Project Status	de maximis, inc. / AECOM	Monthly	Monthly	Progress report	15th of each month
Planning and Development of Study Objectives	de maximis, inc. / AECOM	April 2015	June 2015	QAPP	June 2015
Collection of One Year Post - Removal Action Samples and Submission for Analysis	AECOM	August 2015	August 2016	Sample submission to laboratories	At time of collection
Laboratory Analysis	AECOM	October 2015	September 2016	Analytical data to CPG	30 days after collection. See Worksheet #30 for turnaround times.
Data Validation and Verification of Analytical Data; Survey Data Verification	AECOM	November 2015	October 2016	Validated data with progress report	15th of each month
Preparation and Delivery of Results Summary to USEPA	de maximis, inc. / AECOM	December 2015	November 2016	Draft Results Summary Report	November 2016

[1] Project Schedule/Timeline Table for initial one year after the completion of the removal action monitoring event (two attempts to complete the first chemical monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction). A second monitoring event is proposed for five years after the completion of the removal action. A schedule and timeline for that work will be developed at the time of mobilization for that monitoring event.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

As shown in **Figures 2 through 4**, data were compiled for consideration in developing a sampling approach, including:

- Extent of area dredged and capped based on the RM 10.9 Removal Action Final Construction Report (CH2MHill, in preparation); the area capped includes approximately 2.2 acres downstream of the utility corridor (no-dredge zone) and 2.1 acres upstream of the utility corridor.
- Extent of hard pan area based on the RM 10.9 Removal Action Final Construction Report (CH2MHill, in preparation).
- Post-dredge sediment data for 2,3,7,8-TCDD, PCB-52, and phenanthrene.
- Sediment characterization data for 2,3,7,8-TCDD, PCB-52, and phenanthrene (sample interval of 2.5 to 3.5 ft).
- Underlying sediment grain size.
- Upwelling velocities at nearest seepage meters.

The proposed sampling locations are presented in **Figure 5**. A biased (targeted) approach was used to identify seven locations to provide sufficient coverage to meet DQO 2 and as shown on Worksheet #18 by monitoring areas of potential recontamination from the no-dredge zone (two samples) and areas of potentially higher flux of COCs into the cap (five samples) including:

- Two locations to assess the "edge effects" both upstream of and downstream of the utility corridor (as requested by USEPA).
- One location downstream of the utility corridor in the area of sandier sediments which exhibited the highest upwelling velocity.
- Two additional locations downstream of the utility corridor in one area of higher underlying concentrations of all three COPCs and one area near the location of the maximum concentration of phenanthrene based on the post-dredge data.
- Two additional locations upstream of the utility corridor in areas of higher underlying concentrations of 2,3,7,8-TCDD and PCBs and lower upwelling velocities.

Three additional locations selected by USEPA are also included for a total of ten locations. These stations were added based on contaminant concentration, groundwater flux rate and spatial distribution.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

On December 1, 2015, USEPA in collaboration with the CPG identified adjusted sample locations based on projected water levels and the CPG's stated field constraints (e.g, accessing locations on foot, no in-water work or wading, etc.). During a conference call on December 4, 2015, the CPG agreed to make a best effort to safely access these locations during the December 9, 10, and 11 sampler deployments. These USEPA proposed locations are shown on **Figure 6**. These locations were also the target locations for the June 2016 sampler deployments.

This approach results in a density of sampling locations of 2.3 per acre (10 locations in 4.3 acres of capped area, not including duplicate and QA/QC samples).

The sampling techniques for the SPME samplers assume the ability to walk to each location. Due to the armor layer in the cap design, insertion of the samplers using either a boat-based platform or divers was deemed unreliable. Sampling will occur, therefore, at low tides and during a period of low river stage. A flow of less than 600 cubic feet per second (approximately 1.25 foot stage) for the Lower Passaic River at the Dundee Dam gage station will be targeted. At this stage, with a low tide, the majority of stations should be exposed and sampling may occur. If the river stage is elevated during the targeted retrieval time, retrieval will be postponed until the river stage returns to lower flows. If any stations cannot be accessed, USEPA will be contacted and alternate locations may be identified. Close and constant coordination between the CPG and USEPA will be maintained during field activities. This coordination will help to ensure that any proposed major deviations from the work plan, including changes in sample location, can be reviewed by USEPA and, if acceptable, approved in "real time" prior to implementation

Although hard pan areas will be included in physical monitoring, chemical (porewater) monitoring will not be conducted in these areas due to significantly lower potential flux of COPCs and no anticipated upwelling, and only a residual layer of sediments with lower concentrations (as shown in Figures 2 through 4) and thus minimal mass of COPCs.

Porewater data will be obtained at three depths at each of the ten locations including the underlying sediment (below the active layer), top of the active layer, and top of the armor layer. As discussed in the RM 10.9 Removal Action Final Construction Report (CH2MHill, in preparation), the average thicknesses of the active layer and armor layer were 10.5 and 15.2 inches, respectively. In addition, approximately 6 inches of sand was placed on the cap as a habitat layer to fill the voids in the armor stone and to provide a relatively smooth cap surface with a design goal of no net increase in cap elevation above the armor layer. The approximate depths of the SPME samplers are shown in the conceptual cap section in **Figure 7**. Target locations are provided in Worksheet #18, but the actual locations may be slightly different, depending on the results of probing at each location, and accessibility. Upon deployment of the passive samplers, the portion of the sampler extending above the sediment surface will be cut down to as close as possible to the sediment surface (and the tubing capped) to lessen the potential for the sampler to be damaged by debris or ice.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

A surface sediment sample will be collected within 8 inches of each of these SPME profile locations (8 inches from the armor layer SPME sample) immediately prior to the retrieval of the SPME samplers. These surface sediment samples will be collected from the soft sediments deposited on top of the sand habitat layer and will include collection of sediment from the full thickness of the soft sediments above the habitat layer. If soft sediments are not present at a location, or cannot be distinguished from the sand habitat layer, the surface sediment samples will be collected from the sediment surface to approximately 3 inches below the sediment surface to focus the sampling at the sediment surface where potential newly deposited sediment may be present and not to sample the bottom portion of the clean sand of the habitat layer. Samples will be collected at low tide, during a low river stage to ensure each station can be reached on foot.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

Porewater Samples: SPME samples will be analyzed to determine the concentrations of the three COPCs (2,3,7,8-TCDD, PCB-52, and phenanthrene) on the sorbent. These concentrations will be used to estimate dissolved concentrations utilizing fiber-water partition coefficients from appropriate literature sources. Based on the cap modeling conducted by the CPG and presented to USEPA, porewater concentrations in the top of the active layer and top of the armor layer in the near term (e.g., 10 years) are expected to be well below estimated detection limits (calculated detection limits are anticipated to be in the pg/L to ng/L range depending on the analyte). For the RM 10.9 design (CH2MHill, 2013), porewater samples were obtained by centrifuging sediment samples followed by settlement of solids. As the organic COPCs were not filtered, the measured concentrations are believed to be orders-of-magnitude higher than the corresponding freely dissolved concentrations calculated by the CapSim model (CH2MHill, 2013). SPME fibers will be rinsed to remove particulate sediment and the calculated porewater values will reflect only the freely dissolved COPC concentrations. Thus, it is anticipated that the dissolved concentrations to be measured by the SPMEs in the underlying sediment will be significantly less than the averages of the porewater samples collected for the design of the cap (4.6 ng/L for 2,3,7,8-TCDD, 13.9 ug/L for PCBs, and 1.3 ug/L for phenanthrene).

Monitoring will include two rounds of samples to evaluate conditions approximately one year (two attempts to complete the first chemical monitoring event were made within approximately 18 months after cap completion, and these attempts were unsuccessful. A third attempt is being made approximately two years following cap construction) and five years after construction. Samples will be collected at three depths at ten locations.

Surface Sediment Samples: Surface sediment samples will be collected from a location within 8 inches of the SPME location for the armor layer sample, immediately prior to the retrieval of the SPME, and will be analyzed for the same analytes as the porewater samples. Surface sediment samples will be collected with a hand auger or stainless steel spoon.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table [1,2]

Station Location			Siting Rationale						Approximate SPME Sample Depths (inches below top of cap)[7,8]			Target Locations North American Datum (NAD) 83 NJ State Plane Feet[6]	
				Elevated COPC Concentration in Sediment									
River Mile	Station ID	Approximate Water Depth[1] (feet)	Cap Thickness (feet)[2]	2,3,7,8-TCDD > 3,610 ng/kg[3]	PCB 52 > 443,000 ng/kg4	Phenanthrene >4250 ug/Kg[5]	Adjacent to No Dredge Area	Upwelling[6] 307 cm/yr	Underlying Sediment	Active Layer	Armor Layer	Easting	Northing
10.77	15A-0601	7	2.5	N	Y	Y	N	Lower	31-36	15-20	2-7	592589.8	722623.3
10.80	15A-0602	5	2.5	Y	Y	Y	N	Lower	31-36	15-20	2-7	592674.7	722762.3
10.84	15A-0603	5	2.5	Y	Y	Y	N	Lower	31-36	15-20	2-7	592768.7	722913.1
10.87	15A-0604	8	2.5	N	N	N	N	Higher	31-36	15-20	2-7	592847.1	723072.0
10.89	15A-0605	5	2.5	N[10]	N[10]	N[10]	Y – Downstream	Higher[10]	31-36	15-20	2-7	592959.0	723096.4
10.93	15A-0606	4	2.5	N[10]	N[10]	N[10]	Y - Upstream	Lower[10]	31-36	15-20	2-7	593154.9	723208.9
10.99	15A-0607	6	2.5	Y	Y	Y	N	Lower	31-36	15-20	2-7	593392.0	723337.2
11.01	15A-0608	5	2.5	Y	Y	N	N	Lower	31-36	15-20	2-7	593516.7	723374.4
11.04	15A-0609	7	2.5	Y	Y	Y	N	Lower	31-36	15-20	2-7	593640.6	723422.2
11.10	15A-0610	6	2.5	Y	Y	N	N	Lower	31-36	15-20	2-7	593936.5	723503.4

Notes:

1 Approximate water depth based on estimated mean tide elevation and from 2012 bathymetry survey sediment elevations

2 Average based on completion report (CH2MHill, 2014)

3 Lowest value on concentration bracket for nearest location on Figure 2

4 Lowest value on concentration bracket for nearest location on Figure 3

5 Lowest value on concentration bracket for nearest location on Figure 4

6 Relative to upwelling velocity used in cap design (307 cm/yr)

7 Surface sediment samples will be collected at each station.

8 These depths are approximate and may be adjusted following review of the bathymetric survey results for evidence of consolidation or erosion as confirmed by the probing survey. Any changes to the sampling depths based on these surveys will be provided to Region 2 for review and approval.

9 All locations need to be accessible by foot during low tides and low river stage. If a location is not accessible on foot, it may be relocated in consultation with USEPA. Close and constant coordination between the CPG and USEPA will be maintained during field activities. This coordination will help to ensure that any proposed major deviations from the work plan, including changes in sample location, can be reviewed by USEPA and, if acceptable, approved in "real time" prior to implementation. On December 1, 2015, USEPA in collaboration with the CPG identified adjusted sample locations based on projected water levels and the CPG's stated field constraints (e.g, accessing locations on foot, no in-water work or wading, etc.). During a conference call on December 4, 2015, the CPG agreed to make a best effort to safely access these locations during the December 9, 10, and 11 sampler deployments. These USEPA proposed locations with revised coordinates are shown on Figure 6. These locations were also the target locations for the June 2016 sampler deployments. USEPA agreed on the 12/04/2015 conference call that the USEPA onsite oversight personnel for this work will have the authority to approve changes in sample locations due to accessibility and that such changes will be acceptable to USEPA.

10 Not a siting rationale

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analyte	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time[c] (preparation/ analysis)
Sediment	Phenanthrene	Low	AP-2	45 g minimum	8 ounce (oz) wide mouth glass jar (amber preferred)	During shipment: 0-6°C; store in the dark Upon arrival at lab: store at <4°C in the dark [g]	30 calendar days to preparation[e,f]; 40 calendar days from preparation to analysis
Sediment	PCB 52	Low	AP-3	45 g minimum	8 oz wide mouth glass (amber preferred)	During shipment: 0-6°C; store in the dark; upon arrival at lab: store at <-10°C in the dark [g]	365 calendar days for preparation and analysis
Sediment	2,3,7,8TCDD	Low	AP-1	20 g	4 oz wide mouth glass (amber preferred)	During shipment: 0-6°C; store in the dark; upon arrival at lab: store at <-10°C in the dark [g]	365 calendar days for preparation and analysis
SPME fibers	Phenanthrene	Low	AP-2	120 cm total fiber length	4 oz wide mouth glass (amber preferred)	During shipment: 0-6°C; store in the dark; upon arrival at lab: store at <4°C in the dark [g]	30 calendar days to preparation[e,f]; 40 calendar days from preparation to analysis
SPME fibers	PCBs 52	Low	AP-3	120 cm total fiber length	4 oz wide mouth glass (amber preferred	During shipment: 0-6°C; store in the dark; upon arrival at lab: store at <4°C in the dark [g]	365 calendar days for preparation and analysis

QAPP Worksheet #19 (UFP-QAPP Manual Section 3.1.1) Analytical SOP Requirements Table

Matrix	Analyte	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Sample Size[b]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time[c] (preparation/ analysis)
SPME fibers	2,3,7,8-TCDD	Low	AP-1	120 cm total fiber length	4 oz wide mouth glass (amber preferred	During shipment: 0-6°C; store in the dark; upon arrival at lab: store at <4°C in the dark [g]	365 calendar days for preparation and analysis

[a] Refer to Worksheet #23 for SOP titles.

[b] Sample size is the minimum requested by each laboratory to perform the requested analysis; minimum sample size requirements reflect the additional sample needed to permit the laboratory to obtain a dry aliquot of sufficient size to reach project QL goals assuming samples may contain up to 50% moisture for sediment.

[c] Begins at time of collection of sediment or SPME fiber retrieval.

[e] Samples will be frozen at the laboratory (< -10°C) after aliquot is removed for extraction.

[f] The holding time for frozen samples is extended to 100 days per MPI QAPP modification (January 2007c).

[g] Samples will be stored frozen (< -10°C) and in the dark after receipt and log-in at the laboratory. When samples are scheduled for extraction, they will be removed from the freezer and allowed to thaw at room temperature until at a consistency where the sample can be mixed and a representative aliquot taken for analysis. The time samples are removed from the freezer and the time the remaining sample is returned to storage will be recorded; extraction will begin within 8 hours of the time samples are removed from the freezer.

QAPP Worksheet #20 (UFP-QAPP Manual Section 3.1.1) Field Quality Control Sample Summary Table

Matrix	Analyte	Conc. Level	Analytical and Preparation SOP Reference [a]	No. of Sampling Locations (No. of Samples)[b]	No. of Field Duplicates[c]	No. of Rinsate Blanks [d]	No. of Field Blanks[e]	Total No. of Samples to Lab
SPME Fibers	Phenanthrene	Low	AP-2	10 (30)	3	0	1	34
Sediment	Phenanthrene	Low	AP-2	10 (10)	1	1	0	12
SPME Fibers	PCB 52	Low	AP-3	10 (30)	3	0	1	34
Sediment	PCB 52	Low	AP-3	10 (10)	1	1	0	12
SPME Fibers	2,3,7,8-TCDD	Low	AP-1	10 (30)	3	0	1	34
Sediment	2,3,7,8-TCDD	Low	AP-1	10 (10)	1	1	0	12

[a] Refer to Worksheet #23 for SOP title

[b] The estimated number of samples was based on the following assumptions:

A surface grab sample will be taken at 10 locations. Samples will be collected from approximately 0 to 3 inches.

SPME samples will be taken at 10 locations. Samples will be collected of the underlying sediments (approximately 31 to 36 inches below the top of the cap), cap active layer (approximately 15 to 20 inches below the top of the cap), and armor layer (approximately 2 to 7 inches below the top of the cap). These depths are approximate and may be adjusted following review of the bathymetric survey results for evidence of consolidation or erosion as confirmed by the probing survey. Any changes to the sampling depths based on these surveys will be provided to Region 2 for review and approval. As stated above, probing cannot distinguish between the active layer and underlying sediments. Therefore the top of screened interval of the active layer SPME sampler will be installed immediately (e.g., 1 inch) below the armor layer/geotextile and the top of screened interval of the underlying sediment SPME sampler will be installed at a depth below the geotextile based on the as-constructed thickness of the active layer (approximately 10 inches) plus 6 inches.

[c] Field duplicates will be collected at a frequency of 1 per 10 samples unless noted otherwise. Field duplicates for sediment will be collected by homogenizing the sediment collected from the grab and then distributing the sample material between two sets of containers, each uniquely identified. SPME fiber field duplicate samples will be collected (as co-located samples) using a second inserted sampling device at a sample location. All three depths of SPME fibers will be analyzed as field duplicates. The parent sample and the field duplicate will be submitted to the laboratory, analyzed, and reported as separate samples.

[d] Equipment rinsate blanks will be collected at a frequency of one per sampling event for each set of decontaminated equipment utilized for sediment sampling.

[e] A field blank will be collected using one set of SPME fibers prepared in a sampling device. The fibers will be placed in a sampling device and the sampling device will be carried to the sampling locations retained by the field team for a minimum of 60 days (same duration as SPME fibers in the field) and then sent to SGS.

QAPP Worksheet #21 (UFP-QAPP Manual Section 3.1.2) Project Sampling SOP References Table

The following is a list of all SOPs associated with project sampling including, but not limited to, sample collection, sample preservation, equipment cleaning and decontamination, equipment testing, inspection and maintenance, supply inspection and acceptance, and sample handling and custody.

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
LPR-G-01	Field Records	AECOM	NA	No	Appendix B
LPR-G-02	Navigation/Positioning	AECOM	GPS	Yes (see below)	Appendix B
LPR-G-03	Equipment decontamination	AECOM	Various – see Appendix B	No	Appendix B
LPR-G-04	IDW handling and disposal	AECOM	Various – see Appendix B	No	Appendix B
LPR-G-05	Sample custody	AECOM	NA	No	Appendix B
LPR-G-06	Packaging and shipping	AECOM	NA	No	Appendix B
LPR-S-01	Sediment grab sampling	AECOM	Trowel, shovel, hand auger	No	Appendix B
LPR-S-05	Installation and Recovery of SPME Sampling Device in Sediment	AECOM	Modified Henry Sampler	No	Appendix B
SOP-8	Procedure for sediment probing	MPI	Steel rod	Yes (see below)	Appendix B

LPR-G-02 is modified by this worksheet for this task as follows: “Locations will be target locations stored in the Toughbook or Yuma computer and retrieved in the field. All stations are “walk to” stations. Locations will be recorded using a Trimble Pro XH GPS and the data will be post-processed by AECOM to increase accuracy.”

SOP-8 – Section II. Modified to include a Trimble Pro XH GPS unit and a slide hammer.

SOP- 8 – Section III. 1 is modified by this worksheet as follows: “Using the Trimble Pro XH GPS system, walk to the pre-programmed target coordinates for each SPME sample location.” 3 is modified as follows: “Probing will be conducted within one foot of the target location to maximize accuracy of layer thickness at the sampling locations.” 4 is modified to include: “A slide hammer may be used to penetrate the armor and geotextile layers in the cap.”

Procedural modifications to these documents may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification will be approved in advance by the Project QA Manager and Task Manager and communicated to the CPG

QAPP Worksheet #21 (UFP-QAPP Manual Section 3.1.2) Project Sampling SOP References Table

Coordinator and to the USEPA RPM. Close and constant coordination between the CPG and USEPA will be maintained during field activities. This coordination will help to ensure that any proposed major deviations from the work plan, including changes in sample location, can be reviewed by USEPA and, if acceptable, approved in “real time” prior to implementation. Deviations will be documented in the field records.

QAPP Worksheet #22 (UFP-QAPP Manual Section 3.1.2.4) Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Trimble Pro XH GPS	Per manufacturer's specifications.	Per manufacturer's specifications.	Per manufacturer's specifications.	Per manufacturer's specifications.	Per manufacturer's specifications.	Per manufacturer's specifications.	Per manufacturer's specifications.	AECOM FTM or designee.	NA

[1] Refer to the Project Sampling SOP References table (Worksheet #21).

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

Reference Number[a,b]	Primary Method Reference[b]	Laboratory SOP Title, Revision Date, and/or Number	Definitive or Screening Data	Analyte	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
AP-3	USEPA 1668C	Standard Operating Procedure for the Analysis of Polychlorinated Biphenyls (PCBs), HRMS PCBs, DC_367, Rev. 9, 8/04/2015	Definitive	PCB 52	HRGC/HRMS	SGS, Wilmington, NC	Minimum sediment aliquot size permitted is 1 g; Toluene Soxhlet /Dean Stark (SDS) extraction option is specified. A special labeled extraction standard will be used to quantify PCB-52 by isotope dilution.
AP-1	USEPA 1613B	Standard Operating Procedure for the Analysis of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDD/Fs), Dioxin/Furan, DC_364, Rev. 6, 8/04/2015	Definitive	2,3,7,8-TCDD	HRGC/HRMS	SGS, Wilmington, NC	Minimum sediment aliquot size permitted is 1 g; Toluene SDS extraction option is specified for sediment.
AP-2	California EPA Air Resources Board Method 429	Standard Operating Procedure for the Sample Preparation and Analysis of PAHs by Isotope-Dilution, HRGC/HRMS, AP-CM-4, Rev. 9, 8/04/2015	Definitive	Phenanthrene	HRGC/HRMS	SGS, Wilmington, NC	Minimum sediment aliquot size permitted is 1 g; Toluene SDS extraction option is specified for sediment.

[a] All SOPs are contained in Appendix C.

[b] It is expected that the procedures outlined in these SOPs will be followed. Procedural modifications to individual SOPs may be warranted depending upon an individual sample matrix, interferences encountered, or limitations imposed by the procedure. Deviations from individual SOPs will be documented in the laboratory

QAPP Worksheet #23 (UFP-QAPP Manual Section 3.2.1) Analytical SOP References Table[a]

records. Substantive modification to any SOP will be approved in advance by the AECOM Project QA Manager and AECOM Task Manager and communicated to the CPG Coordinator and to the USEPA Remedial Project Manager. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

QAPP Worksheet #24 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[a]
HRGC/HRMS (PCB 52)	Perfluorokerosene (PFK) Tune; Retention time calibration, initial calibration, continuing calibration as required in SOP	ICAL after instrument set up, after major instrument changes and when continuing calibration criteria are not met. Calibration verification minimum every 12 hours	ICAL % Relative Standard Deviation (RSD) < 20% for target analytes calculated by isotope dilution. %RSD < 20% for target analytes calculated by internal standard. Continuing calibration per SOP Table 7	Inspect system, correct problem, rerun calibration and affected samples	Analyst	AP-3
HRGC/HRMS (2,3,7,8-TCDD)	PFK Tune; initial and continuing calibration as required in SOP	ICAL after instrument set up, after major instrument changes and when continuing calibration criteria are not met. Continuing calibration minimum every 12 hours	%RSD for mean response of unlabeled standards $\leq$ 10%; labeled reference compounds ± 20%; Continuing calibration per SOP Table 6	Inspect system, correct problem, rerun calibration and affected samples	Analyst	AP-1
HRGC/HRMS (Phenanthrene)	PFK Tune; initial and continuing calibration as required in SOP	ICAL after instrument set up, after major instrument changes and when continuing calibration criteria are not met. Continuing calibration minimum every 12 hours	ICAL %RSD < 20% for target analytes calculated by isotope dilution; Continuing calibration per SOP	Inspect system, correct problem, rerun calibration and affected samples	Analyst	AP-2

[a] Refer to the Analytical SOP References table (Worksheet #23). All SOPs are contained in Appendix C.

QAPP Worksheet #25 (UFP-QAPP Manual Section 3.2.2) Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[a]
HRGC/HRMS-(Phenanthrene)	Clean sources; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps once per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	AP-2
HRGC/HRMS (PCB 52)	Clean sources; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps once per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	AP-3
HRGC/HRMS (2,3,7,8-TCDD)	Clean sources; maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year; other maintenance as needed	See SOP	See SOP	Analyst or Section Supervisor	AP-1

[a] Refer to the Analytical SOP References table (Worksheet #23). All SOPs are contained in Appendix C.

QAPP Worksheet #26 (UFP-QAPP Manual Appendix A) Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): AECOM Field Team (see Worksheet #21 for a list of the sample collection methods)
Sample Packaging (Personnel/Organization): AECOM Field Team
Coordination of Shipment (Personnel/Organization): AECOM Field Team
Type of Shipment/Carrier: UPS or FedEx for overnight delivery or laboratory courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
Sample Custody and Storage (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
Sample Preparation (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
Sample Determinative Analysis (Personnel/Organization): Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services)
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples will not be stored in the field but will be shipped to the designated laboratory the same day as collection or no later than the day after collection. If circumstances require that the samples be stored in the field, they will be maintained under the method-specified conditions (e.g., kept at 4 ± 2° C) and shipped to the laboratory with sufficient time to meet holding times. A field blank consisting of fibers placed in a sampling device will be carried to the sampling locations, retained by the field team for 28 days (same duration as SPME fibers in the field) under method-specified condition (e.g., kept at 4 ± 2° C) and. then sent to SGS with the samples.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Sample extraction and digestion holding times are summarized in Worksheet #19.
SAMPLE DISPOSAL
Personnel/Organization: Assigned laboratory personnel (see Worksheet #30 for laboratories providing analytical services).
Number of Days from Analysis: Laboratory is required to give AECOM 30 days' notice prior to intent to discard any project samples.

QAPP Worksheet #26 (UFP-QAPP Manual Appendix A) Sample Handling System

Sample Handling and Custody

Sample custody procedures ensure the timely, correct, and complete analysis of each sample for all parameters requested. A sample is considered to be in someone's custody if it:

- Is in his/her possession
- Is in his/her view, after being in his/her possession
- Is in his/her possession and has been placed in a secured location
- Is in a designated secure area

Sample custody documentation provides a written record of sample collection and analysis. The sample custody procedures require the specific identification of samples associated with an exact location and the recording of pertinent information associated with the sample, including time of collection and any preservation techniques, and a chain-of-custody (COC) record which serves as physical evidence of sample custody. Custody procedures will be similar to the procedures outlined in USACE's *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001) and the USEPA's *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2007b). The COC documentation system provides the means to individually identify, track, and monitor each sample from the time of collection through final data reporting. Sample custody procedures are developed for three areas: sample collection, laboratory analysis, and final evidence files, which are described in Worksheet #27 and SOP LPR-G-05.

Field Sample Handling and Custody

Field records provide a means of recording information for each field activity performed at the site. COC procedures document pertinent sampling data and all transfers of custody until the samples reach the analytical laboratory. The sample packaging and shipment procedures summarized in Worksheet #27 are designed to ensure that the samples arrive at the laboratory with the COC intact. Specific preservation procedures required for each analytical method are described in Worksheet #19.

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): The field sample custody procedures including sample packing, shipment, and delivery requirements, are discussed in Worksheet #26. Sample management information is also provided in SOPs LPR-G-05 and LPR-G-06.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Each laboratory has a sample custodian who accepts custody of the samples and verifies that the information on the sample labels matches the information on the COC. The sample custodian will document any discrepancies, document sample condition upon receipt at the laboratory and will sign and date all appropriate receiving documents. Additional information on laboratory sample receiving procedures is provided in the text below this summary table.

Sample Identification Procedures: Each sample will be assigned a unique sample identification number using the Lower Passaic River Data Management System. This identification nomenclature will consist of an alphanumeric code that identifies the program, sample location (including depth interval if needed), and sample type. Details of sample identification are provided below.

COC Procedures: A COC will accompany all samples from the time of sampling through all custody transfers. Samples of the COC forms are provided in LPR-G-05; the COC procedures are summarized below and in SOP LPR-G-05 provided in Appendix B.

Sample Identification

Samples will be uniquely identified at the time of collection. The sample ID will include the following alpha (A) or numeric (N) characters:

- NNA – Event (the year and the event within that year). It is anticipated that the RM 10.9 Post-Construction Monitoring will be the first LPR event in 2015. Therefore, “15A” will identify the RM 10.9 Post Construction Monitoring event. However, if the schedule changes, the event code will be modified as appropriate.
- NNNN – Location (location number preceded by a “0”). These locations begin with 0601.
- A – Sample Matrix: S (sediment), T (trip blank), E (SPME).
- N – Sequential number representing sample number. Note that each sample is assigned a unique number upon retrieval, regardless of its acceptability.

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

- A – Depth. This character represents the relative depth interval, with "A" being most surficial, and "B", and "C" being assigned with increasing depth. "X" is used if there is no associated depth (see below for example). For the SPMEs, “A” will be for the armor layer, “B” for the active layer, and “C” for the underlying sediment.
- A – Sample type: S (field sample), T (field duplicate), R (equipment rinsate blank), F (field blank for SPMEs)

For example,

15A-0601-E1-BT is the SPME field duplicate, second depth interval (active layer), for Station 601.

15A-0604-S2-XR is the equipment rinsate blank on sediment sampler associated with Station 604, second sediment sample attempt.

Note that although equipment rinsate blanks are assigned an ID related to a sample recently processed or collected, this is for identification purposes only. Equipment rinsate blanks are collected weekly and are considered reflective of decontamination procedures for the week. They are therefore applicable to all samples collected that week using a particular type of equipment.

Chain of Custody Procedure

The COC form serves as an official communication to the laboratory detailing the specific analyses required for each sample. The COC record is prepared by the field sample custodian and accompanies samples from the time of sampling through all transfers of custody. The COC will be retained by the laboratory which analyzes and archives the samples. Three copies of the COC are created; one copy is retained in the field and two copies are sent to the laboratory.

Transfer of Custody and Shipment

Sample custody must be maintained from the time of sampling through shipment and receipt at the laboratory. The procedures for custody transfer are outlined in SOP LPR-G-05 (included in Appendix B).

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Sample Packaging and Shipping Requirements

Sample custody must be maintained through shipment of samples to the contracted laboratory. All samples will be packaged and shipped at the end of each day unless other arrangements have been made with the laboratory. Samples will be delivered directly to the laboratory by sampling personnel or will be shipped using the procedures outlined in SOP LPR-G-6 (Appendix B).

Laboratory Custody Procedures

Each contracted laboratory will have a SOP that details the procedures used to document sample receipt and custody within the laboratory. The following procedures must be addressed in the laboratory custody SOP:

- Each laboratory must have a designated sample custodian who accepts custody of the samples at the time of delivery to the laboratory and verifies that the information on the sample labels matches the information on the COC. The sample custodian must sign and date all appropriate receiving documents and note any discrepancies in sample documentation as well as the condition of the samples at the time of receipt.
- Once the samples have been accepted by the laboratory, checked, and logged in, they must be maintained in accordance with laboratory custody and security requirements as outlined in the laboratory QMP.
- To ensure traceability of samples during the analytical process the laboratory will assign a sample ID number based on procedures outlined in the laboratory QMP or laboratory SOP.
- The following procedures, at a minimum, must be documented by the laboratory:
  - Sample extraction /preparation
  - Sample analysis
  - Data reduction
  - Data reporting
- Laboratory personnel are responsible for sample custody until the samples are returned to the sample custodian.

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

- When sample analysis and QC procedures are completed any remaining sample must be stored in accordance with contractual terms. A minimum of 30 days' notice must be provided before disposal of any sample. Data sheets, custody documents and all other laboratory records must be retained in accordance with contractual agreements.

Final Evidence Files

Laboratory records including COCs and other sample receiving records, sample preparation and analysis records, and the final data package become part of the laboratory final evidence file and must be retained as required by the contractual agreement. A portable document format (PDF) copy of the data package and associated electronic deliverable must be provided to AECOM in accordance with the contractual agreement and will be retained by AECOM along with associated field records and other related correspondence.

Final evidence files as retained by AECOM will include, but not be limited to, correspondence (paper and e-mail), plans, contractual documents, maps and drawings, field data, calculations, assessment reports, laboratory deliverables, progress and data reports. This information will be maintained in a secure area according to the procedures outlined in the Lower Passaic River Restoration Project QMP (AECOM 2009).

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	SPME fibers or Sediment
Analyte	Phenanthrene
Concentration Level	Low
Sampling SOP	LPR-S-01, LPR-S-05
Analytical Method/ SOP Reference	AP-2
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	SGS-Wilmington, NC
Number of Sample Locations	10

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[a]	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria[a]
MB, Field Blank, and Equipment Rinsate Blank	MB - 1/Batch (20 samples); Equipment Rinsate Blank: 1 per sampling event SPME Field Blank: 1 per sampling event	No Target Compounds>QL	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >20x blank result or sample results not detected.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>QL
Pre-extraction Internal Standards	Every sample	40-150%R	Check calculations. Ensure that instrument performance is acceptable. If signal/noise (S/N) ratio is <10, re-prepare and reanalyze sample. If S/N ratio is >10, flag the data.	Analyst/Section Supervisor	Accuracy/Bias	40-150%R

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[a]	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria[a]
BCS	1/Batch (20 samples)	Native compounds by isotope dilution %D vs ICAL ≤ 30; Labeled standard %D vs ICAL ≤ 50%; Native Compound RPDs ≤ 10% ; Labeled Standard RPDs ≤ 20%	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Native compounds by isotope dilution %D vs ICAL ≤ 30; Labeled standard %D vs ICAL ≤ 50%; Native Compound RPDs ≤ 10% ; Labeled Standard RPDs ≤ 20%
Field Duplicate	1/20 field samples	RPD ≤ 50% if both samples are > 5x QL	Evaluate during data validation. Qualify data.	AECOM Data Validators	Precision	RPD ≤ 50% if both samples are >5x QL

[a] Full method QC elements may be reviewed however only elements associated with the single target analyte specified in Worksheet #15 are relevant.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	SPME fibers or Sediment
Analyte	PCB 52 (HRGC/HRMS)
Concentration Level	Low
Sampling SOP	LPR-S-01, LPR-S-05
Analytical Method/ SOP Reference	AP-3
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	SGS-Wilmington, NC
Number of Sample Locations	10

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[a]	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria[a]
MB, Field Blank, and Equipment Rinsate Blank	MB - 1/Batch (20 samples); Equipment Rinsate Blank: 1 per sampling event SPME Field Blank: 1 per sampling event	No Target Compounds>1/10 concentration in associated samples	Assess impact on data; Re-extract or qualify data as necessary	Analyst/Section Supervisor	Accuracy/Bias Contamination	No Target Compounds>1/10 concentration in associated samples
Instrument Blank	Once per 12 hours if MB is not run	No Target Compounds>1/10 concentration in associated samples	Assess impact on data; Re-extract or qualify data as necessary	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/10 concentration in associated samples
BCS	1/Batch (20 samples)	Native compounds by isotope dilution %D vs ICAL ≤ 20%; Labeled standard %D vs ICAL ≤ 30%; Native Compound RPDs ≤ 10% and ≤ 20% for	Reanalyze affected samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias	Native compounds by isotope dilution %D vs ICAL ≤ 30%;; Labeled standard %D vs ICAL ≤ 30%; Native Compound RPDs ≤ 10% and ≤ 20% for

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[a]	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria[a]
		labeled standard RPDs				labeled standard RPDs
Pre-extraction Internal Standards	Spiked into every sample and QC sample	Per EPA Method 1668C Table 6	Check all calculations for error; ensure that instrument performance is acceptable; Assess impact on data; Re-extract or qualify data as necessary.	Analyst/Section Supervisor	Accuracy/Bias	Per EPA Method 1668C Table 6
Field Duplicate	1/20 field samples	RPD ≤ 50% if both samples are > 5x EML	Evaluate during data validation. Qualify data.	AECOM Data Validators	Precision	RPD ≤ 50% if both samples are >5x EML

[a] Full method QC elements may be reviewed however only elements associated with the single target analyte specified in Worksheet #15 are relevant.

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

Matrix	SPME fibers or sediment
Analyte	2,3,7,8-TCDD (Isotope Dilution Mass Spectrometry)
Concentration Level	Low
Sampling SOP	LPR-S-01, LPR-S-05
Analytical Method/ SOP Reference	AP-1
Sampler's Name	AECOM Field Staff
Field Sampling Organization	AECOM
Analytical Organization	SGS- Wilmington, NC
Number of Sample Locations	10

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[a]	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria[a]
MB	MB - 1/Batch (20 samples);	a) No Target Compound exceeding the adjusted QL b) If detected, the concentration should be less than the RL or <10 times the highest concentration found in the sample batch; c) S/N should be >10:1 for isotopically labeled standard added before extraction;	Reanalyze affected samples. A B qualifier is applied to any specific analyte detected in the MB at a concentration above the RL, or the level detected in the blank that is statistically significant relative to that found in the associated sample. An invalid MB requires re-extraction and reanalysis of the samples.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	a) No Target Compound exceeding the adjusted QL b) If detected, the concentration should be less than the RL or <10 times the highest concentration found in the sample batch; c) S/N should be >10:1 for isotopically labeled standard added before extraction;
Field Blank or Equipment Rinsate Blank	1 per sampling event	No Target Compounds >QL	Re-assess equipment decontamination and storage procedures. Qualify data as needed.	AECOM FTM/AECOM Data Validators	Accuracy/Bias-Contamination	No Target Compounds > QL

QAPP Worksheet #28 (UFP-QAPP Manual Section 3.4) QC Samples Table

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[a]	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria[a]
QC Standard	1/Batch (20 samples)	Within statistical control limits	Identify source of variance and assess impact on data reliability. Consider re-extraction and reanalysis of samples if necessary for generating reliable data and sufficient sample is available.	Technical Director	Accuracy/Bias	Within statistical control limits
BCS	1/Batch (<20 samples)	Native Compound %D (vs. ICAL) ≤ 20%; Labeled Standard %D (vs. ICAL) ≤ 30%; Native Compound RPDs ≤ 10%; Labeled Standard RPDs ≤ 20%	Identify source of variance and assess impact on data reliability. Consider re-extraction and reanalysis of samples if necessary for generating reliable data and sufficient sample is available	Technical Director	Accuracy/Bias	Native Compound %D (vs. ICAL) ≤20%; Labeled Standard %D (vs. ICAL) ≤30%; Native Compound RPDs ≤10%; Labeled Standard RPDs ≤20%
Field Duplicate	1/20 field samples	RPD ≤ 50% if both samples are > 5x QL	Evaluate during data validation. Qualify data.	AECOM Data Validators	Precision	RPD ≤ 50% if both samples are >5x QL

[a] Full method QC elements may be reviewed however only elements associated with the single target analyte specified in Worksheet #15 are relevant.

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field notes, field data sheets, field logbooks, photographic records	Field notes, field data sheets, field logbooks, photographic records	Custody records and copies of airbills	Reports of field sampling audits	Progress reports
Custody records and airbills	Field instrument calibration records	Analytical data packages and EDDs	Reports of laboratory audits	Draft Site Results Summary Report - Prepared and submitted to CPG and USEPA.
Communication logs, records or copies of pertinent e-mails	Field measurement data	Communication logs	Validation reports	
QAPP and HASP	QAPP and HASP	Laboratory notebooks and bench sheets documenting sample preparation and analysis	QA reports to management	
Correction action reports and results	Correction action reports and results	Instrument maintenance and calibration records, standard preparation and traceability records	CA reports and results	
Documentation of field modifications	Documentation of field modifications	Laboratory SOPs and documentation of method modifications	Internal laboratory assessments, including internal audits, third-party audit reports, Internal laboratory assessments, including internal audits, and third-party audit reports	
Daily Activity Log	Daily Activity Log	CA logs and documentation of corrective action results		

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

This section describes the project data management process tracing the data from their generation through final use and/or storage. All project data, communications, and other information must be documented in a format useable to project personnel.

Project Document Control System

Project documents are controlled by AECOM's Project Document Control Manager who will maintain and manage hardcopies and electronic copies of all project related documents according to the Lower Passaic River QMP (AECOM 2009). Electronic copies of all information relating to this project are maintained on the project network files which are backed up at least once per day; access to these files is limited to authorized project personnel. All project data and information must be documented in a standard format which is usable by all project personnel.

Data Recording

Data generated during this project will be captured electronically or entered by hand into bound field or laboratory logbooks or preprinted forms (refer to SOP LPR-G-01 in Appendix B). Computer generated laboratory data will be managed using the laboratory information management system (LIMS); the LIMS used by subcontracted laboratories are described in their QA documentation.

Data Quality Assurance Procedures

AECOM will monitor the progress of sample collection to verify that samples are collected as planned. The progress of sample collection and processing will be monitored through the documentation of samples collected and shipped each day. The participating laboratories must maintain a formal QMP to which they adhere and which addresses all data generating aspects of daily operations. A policy of continuous improvement will allow all data generation processes to be reviewed and modified as needed to meet project objectives. Periodic audits of field and laboratory operations will ensure that data collection, documentation and QC procedures are being followed.

Laboratory Data Transmittal

Laboratory data are managed by the laboratory's LIMS beginning with the sample receiving process. Laboratories are required to provide validated data reports (sample results, QC summary information, and supporting raw data) including EDDs within the turnaround times specified in Worksheet #30. EDDs will be provided in an Earthsoft EQuIS® four-file format (modified by AECOM), using reference file tables provided by AECOM. All EDDs will be checked prior to transmittal to AECOM using current versions of Earthsoft's Electronic Data Processor (EDP).

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

Data Storage and Retrieval

Completed forms, logbooks, photographs, data packages, and electronic files will be transmitted regularly to the Project Document Control Manager. Each laboratory will maintain copies of all documents it generates as well as backup files of all electronic data relating to the analysis of samples. Raw data and electronic files of all field samples, QC analyses and blanks must be archived from the date of generation and maintained by each laboratory in accordance with the terms of the contract between AECOM and the laboratory. Project closeout will be conducted in accordance with contractual guidance. As required by the Settlement Agreement all data and other project records will be made available to USEPA.

Data transfer to USEPA will include a Multi-media Electronic Data Deliverable (MEDD) that conforms to the 2007 EPA Region 2 MEDD format. The MEDD will include all qualified and rejected data (including the reported, numerical value for rejected data).

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analyte	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization
SPME fibers	Phenathrene	Low	All	AP-2	30 days	SGS 2714 Exchange Dr. Wilmington, NC 28405 Heather Distel 910.794.1613	NA
SPME fibers	PCB 52	Low	All	AP-3	30 days	SGS 2714 Exchange Dr. Wilmington, NC 28405 Heather Distel 910.794.1613	Test America 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000
SPME fibers	2,3,7,8-TCDD	Low	All	AP-1	30 days	SGS 2714 Exchange Dr. Wilmington, NC 28405 Heather Distel 910.794.1613	Test America 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000
Sediment	Phenanthrene	Low	All	AP-2	30 days	SGS 2714 Exchange Dr. Wilmington, NC 28405 Heather Distel 910.794.1613	NA
Sediment	PCB 52	Low	All	AP-3	30 days	SGS 2714 Exchange Dr. Wilmington, NC 28405 Heather Distel 910.794.1613	Test America 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000

QAPP Worksheet #30 (UFP-QAPP Manual Section 3.5.2.3) Analytical Services Table

Matrix	Analyte	Concentration Level	Sample Locations/ ID Number	Analytical SOP	Data Package Turnaround Time[a]	Laboratory/ Organization	Backup Laboratory/ Organization
Sediment	2,3,7,8-TCDD	Low	All	AP-1	30 days	SGS 2714 Exchange Dr. Wilmington, NC 28405 Heather Distel 910.794.1613	Test America 5815 Middlebrook Pike Knoxville, TN 37921 John Reynolds 865.291.3000

[a] Turnaround time is in calendar days from receipt of the last sample in the data package sample delivery group.

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Internal Lab Audits	Per laboratory QA Manual; at least annually	Internal	Laboratory	Laboratory QA Officer or designee	Laboratory management and staff	Laboratory management and staff	Laboratory QA Officer
External Lab Audits	Audit will be performed at least annually	External	State or national certifying authority	State or national certifying authority auditor.	Laboratory management and staff	Laboratory management and staff	Laboratory management and staff; AECOM Project QA Manager or designee.
Project-Specific Laboratory Readiness Review	Audit will be performed in advance of field work or during the initial stages	External	AECOM	AECOM Project QA Manager, Project Chemist, or designee	Laboratory management and staff	Laboratory management and staff	Laboratory management and staff.

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Response Actions

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Internal Laboratory Audits	Written audit report	Laboratory Manager	Major deficiencies within 24 hours; written report as required by laboratory QA Manual	Memo or as required by laboratory QA Manual	Laboratory Manager, Laboratory PM AECOM Project Chemist, AECOM Project QA Manager, AECOM Task Manager, CPG QA Coordinator, USEPA RPM, USACE PM (if project DQOs are affected)	As required by laboratory QA Manual
External Laboratory Audits by third-party entities	Written audit report	Laboratory Manager	Major deficiencies communicated orally at exit meeting; written report based on policy of external auditing organization	Letter or as required by external auditing organization with possible re-audit	External auditing organization AECOM Project Chemist, AECOM Project QA Manager, AECOM Task Manager, CPG QA Coordinator, USEPA RPM, USACE PM (if project DQOs are affected)	As required by external auditing organization

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Response Actions

Non-Conformance/QC Reporting

A non-conformance is defined as an identified or suspected deficiency in, or deviation from, procedures described in an approved document (e.g., improper sampling procedures, improper instrument calibration, errors in calculations or errors in computer algorithms); an item where the quality of the end product itself or subsequent activities conducted using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with established plans or procedures. Any project staff member that discovers or suspects a non-conformance is responsible for initiating a non-conformance report to the Project QA Manager. The Project QA Manager will evaluate each non-conformance report and provide a response describing the actions to be taken and assigning responsibility for the corrective action. The Task Manager will verify that the nonconforming item or procedure is not used until the corrective action has been performed and found to produce acceptable results. If the non-conformance involves instrumentation or equipment, the device must be tagged to indicate it is defective and not to be used.

A copy of each non-conformance report will be added to the project file. Original non-conformance reports will be maintained by the Project QA Manager.

Assessment

Assessment activities will measure the effectiveness of the project implementation and associated QA/QC activities. Audits are used as a means of monitoring the performance of field and laboratory activities and are conducted by the Project QA Manager or another member of the QA staff. Audits will include systems audits which are more qualitative in nature and will be made at appropriate intervals to ensure that all aspects of the QA program are operative. Performance audits are quantitative audits which are conducted to assess the accuracy of measurement systems

Systems audits will be conducted for field and laboratory operations to assess implementation of QA/QC requirements and determine if the systems under review are capable of meeting project DQOs. Any minor deficiencies noted during an audit will be corrected as soon as possible according to an agreed upon schedule. If a major deficiency is noted during an audit a stop work order will be issued until the deficiency can be corrected and the effectiveness of the corrective action measured and documented. A stop work order may be issued by the Project QA Manager who will notify the AECOM Task Manager and the AECOM PM. The conditions which lead to a stop work order must be documented in sufficient detail to clearly define the problem and identify possible corrective measures. All communications among project staff which address evaluation of the problem and appropriate solutions must be attached to the stop work order. The Project QA Manager, the AECOM Task Manager, and AECOM PM must agree in writing to resume work after review of the data supporting correction of the deficiency. The Project QA Manager will maintain a corrective action log which lists deficiencies that were noted, the individual(s) responsible for follow-up, documentation of the effectiveness of the corrective actions taken, and implementation of procedures to prevent recurrence of the problem.

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Response Actions

A written report will be prepared for all audits regardless of the outcome and submitted to the AECOM Task Manager, AECOM PM, CPG QA Coordinator, and USEPA RPM. Any modifications to the existing program, corrective actions required, or the need for additional audits will be documented.

In addition to participation in any audits conducted by AECOM QA personnel, participating laboratories are required to take part in regularly scheduled performance evaluations and audits required by state and federal agencies as part of ongoing certification or participation in specific contracts and to provide copies of the results of these samples and audits to the Project Chemist. Any change in laboratory ownership, management, or certification status must be immediately reported to the Project Chemist. If any laboratory analysis is found to be out of control, the laboratory must immediately implement corrective action and notify the Project Chemist. The laboratory PM will be responsible for documenting the effectiveness of the corrective action measures before continuing analysis of project samples.

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QAPP Worksheet #33 (UFP-QAPP Manual Section 4.2) QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Progress Reports	Monthly	Due the 15th of each month	AECOM PM / CPG Project Coordinator	USEPA RPM
Audit Reports	Per Audit Schedule in Worksheet #31	Within one month of completion of audit.	AECOM Project QA Manager	AECOM Task Manager, AECOM PM, CPG QA Coordinator, USEPA RPM, USACE PM
Data Validation Reports	After laboratory data are received and validated	See Worksheet #16	AECOM Data Validation Task Manager	AECOM Project QA Manager, Task Manager, and AECOM PM
Nonconformance report	As needed	When a nonconformance is identified	AECOM staff	AECOM Project QA Manager, AECOM Task Manager, USEPA RPM
Corrective Action Reports	When corrective action is required	When corrective action is implemented	AECOM Project QA Manager or designated Task Manager	AECOM PM, AECOM Task Manager, and Project Team Members, CPG QA Coordinator, CPG Project Coordinator, USEPA RPM

The monthly management report will address the results of any corrective actions or audits which took place during the reporting period as well as any trends noted during the data validation process. Problems or issues which arise between regular reporting periods may be identified to management at any time. Information included in the monthly progress report will include:

- Results of audits conducted during the reporting period;
- Discussion of problems with measurement data including issues related to precision, accuracy, completeness, representativeness, and comparability that could affect achievement of the DQOs; and
- A listing of any non-conformance reports or stop-work orders, the associated corrective actions taken, and the outcome of these corrective actions.

QAPP Worksheet #34 (UFP-QAPP Manual Section 5.2.1) Sampling and Analysis Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification)
Field data	Field data will be reviewed for completeness, accuracy and agreement with SOP LPR-G-01 (Field Records).	Internal	AECOM FTM or designee
Chain-of-Custody	The COC will be reviewed initially in the field for complete and correct information.	Internal	AECOM FTM or designee
	Upon receipt at the laboratory the COC will be compared to sample containers and any discrepancies will be resolved.	External	Laboratory Sample Custodian
	During validation the COC will be verified against laboratory receipt and reporting information.	External	AECOM Data Validator
Laboratory Data Packages and EDD	Laboratory data (hard copy and EDDs) will be verified by the laboratory performing the work for completeness and technical accuracy prior to release.	Internal	Laboratory
	Laboratory data will be assessed using the validation procedures described in Worksheets #35 and #36	External	AECOM Data Validator
Audit Reports	Audit reports will be reviewed to confirm that specified corrective actions have been taken, the corrective action has been effective and all documentation of corrective action is attached to the audit report.	Internal	AECOM Project QA Manager
Assessment actions and reports	QA/QC process will be reviewed for agreement with QAPP	External	ddms, Inc.

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Sampling and Analysis Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation
IIa	Field SOPs, field records	Verify conformance to approved sampling and field measurement procedures; ensure that activities met performance criteria; and verify that deviations from procedures or criteria were documented.	Debra Simmons, Project QA Manager/AECOM
IIa	Analytical data deliverables, contractual documents	Verify the required deliverables, analyte lists, method holding times, analytical procedures, laboratory qualifiers, measurement criteria, and project QLs conform to specifications. Verify that deviations from procedures or criteria were documented.	Waverly Braunstein, Validation Coordinator/AECOM
IIa	Field records, database output	Verify transcription of field data from field forms to database.	Jim Herberich, Data Management Task Manager/AECOM
IIa	Custody records, analytical data reports	Review traceability from sample collection through reporting.	Waverly Braunstein, Validation Coordinator/AECOM
IIa	Laboratory EDDs, analytical data reports, database output	Verify EDDs against hard-copy analytical reports.	Jim Herberich, Data Management Task Manager/AECOM
IIa	Data validation reports, database output	Verify that entry of qualifiers was correct and complete.	Waverly Braunstein, Validation Coordinator/AECOM
IIb	Analytical data reports	Verify that reported analytes, holding times, analytical procedures, measurement criteria, and project QLs conform to the QAPP. Verify that deviations from procedures or criteria were documented.	Waverly Braunstein, Validation Coordinator/AECOM
IIb	Analytical data reports, validation guidance	One hundred percent of the data will be validated (see details below)	Waverly Braunstein, Validation Coordinator/AECOM
IIb	QAPP, analytical data reports, validation guidance	Verify that the qualifiers applied during validation were in conformance with the QAPP and specified validation guidance.	Waverly Braunstein, Validation Coordinator/AECOM
IIb	QAPP, data validation reports	Verify that data validation was performed in accordance with the QAPP specifications and that all required peer reviews were conducted. If validation actions deviated from the QAPP specifications and/or regional validation guidance based on professional judgment, verify that rationale was documented.	Debra Simmons, Project QA Manager/AECOM

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Sampling and Analysis Validation (Steps IIa and IIb) Process Table

Data Validation

Validation of each analytical group will be limited to the target analytes listed in Worksheet #15 for that group. At a minimum limited validation will be conducted for the target analytes..

Limited validation will be based on information provided by the laboratory on their QC forms, and will include no or minimal raw data review. At a minimum, limited validation will include the following data elements:

- Agreement of analyses conducted with COC requests
- Holding times and sample preservation
- Initial and continuing calibrations and analytical sequence
- Mass spectrometer tuning
- Internal standard performance
- Laboratory blanks/equipment blanks
- Labeled standard spike recoveries
- BCS results
- Field duplicate results
- Percent solids
- QLs and sample results (limited to evaluating dilutions and re-analyses)

If significant issues (e.g., those affecting achievement of the DQOs) are noted during limited validation, then limited validation will be expanded full data validation including raw data review. Systematic or random errors that would not be detected during a review of the summary forms might include, for example, misidentification or quantitation of compounds, transcription errors, or calculation errors. In addition, limited validation will provide review of key laboratory QC elements, which would highlight potential underlying lab issues which may require further investigation (i.e., full validation effort). If a high frequency of measurement performance issues is found, the issue will be investigated and an additional validation effort may be implemented. AECOM plans to maintain communication/notification systems with the laboratory during the analytical process to circumvent

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Sampling and Analysis Validation (Steps IIa and IIb) Process Table

significant QC issues. If QC issues do arise, investigations and corrective actions will be documented and implemented in a timely fashion to optimize the amount of un-qualified data.

In addition, data packages receiving limited validation will receive a completeness check so that full validation could be performed at a later data, if necessary. The check will verify that the raw data for each sample (including all re-analyses and dilutions) are present and complete. The data supporting the sample results, such as QC samples (MBs, BCS), calibrations, tunes, and preparation logs, will also be reviewed for overall completeness, however, an in-depth inventory to ensure specific association with all sample data will not be performed.

Validation qualifiers will be applied based on the criteria in the QAPP, method-specific Region II validation SOPs, or professional judgment. These will be limited to “J”, “U”, “UJ”, “NJ”, and R, as defined in the Region II validation SOPs. Any results reported as EMPCs due to ion ration, S/N, ratio, or peak retention issues will be qualified as EMPC-J. Reports summarizing data qualification as a result of the validation effort will be prepared.

QAPP Worksheet #36 (UFP-QAPP Manual Section 5.2.2) Sampling and Analysis Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analyte	Concentration Level	Validation Criteria*	Data Validator (title and organizational affiliation)
IIa	SPME fibers	2,3,7,8-TCDD	Low	Region II validation SOP HW-25; QAPP Worksheets #12, #15, #19, #24, and #28	Waverly Braunstein, Validation Coordinator/AECOM (or designate)
IIa	SPME fibers	PCB 52	Low- High	Region II validation SOP HW-46; QAPP Worksheets #12, #15, #19, #24, and #28	Waverly Braunstein, Validation Coordinator/AECOM (or designate)
IIa	SPME fibers	Phenanthrene	Low	QAPP Worksheets #12, #15, #19, #24, and #28	Waverly Braunstein, Validation Coordinator/AECOM (or designate)
IIb	Sediment	2,3,7,8-TCDD	Low	Region II validation SOP HW-25 and/or QAPP Worksheets #12, #15, #19, #24, and #28, whichever is more stringent	Waverly Braunstein, Validation Coordinator/AECOM (or designate)
IIb	Sediment	PCB 52	Low- High	Region II validation SOP HW-46; QAPP Worksheets #12, #15, #19, #24, and #28	Waverly Braunstein, Validation Coordinator/AECOM (or designate)
IIb	Sediment	Phenanthrene	Low	QAPP Worksheets #12, #15, #19, #24, and #28; data will be qualified using Region II SOP HW-22 and HW-25 as guidance	Waverly Braunstein, Validation Coordinator/AECOM (or designate)

* Validation criteria include professional judgment where appropriate and necessary. Note that the most relevant Region II data validation SOPs are used for validation guidance when there is no SOP for the specified method. In those cases, QAPP Worksheets #12, #15, #19, #24, and #28 and/or the analytical method and laboratory SOPs are used as reference and the most relevant Region II data validation SOPs (as identified above) are used for guidance in applying validation qualifiers.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Data Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
AECOM's data validation staff will validate all laboratory data in accordance with the protocols described in Worksheet #36. The Project QA Manager, in conjunction with the project team, will determine whether the analytical data meet the requirements for use in making decisions related to further actions at the site. The results of laboratory measurements will be compared to the DQOs described in Worksheet #11 of this document. SPME sampler analyte mass will be converted to porewater concentrations using the following formula:

$C_{pw} = C_{pdms}/K_{pw}$

Where C_{pw} is the porewater concentration, C_{pdms} is the analyte mass divided by the PDMS sorbent mass (sorbent mass is derived from the fiber length, coating thickness, and sorbent density), and K_{pw} is the PDMS partition coefficient based on literature values (see Worksheet #11).

Describe the evaluative procedures used to assess overall measurement error associated with the project:
During the data validation process the validator will use information confirming sample identification; sample preparation; analysis within holding time; instrument calibration data; and results of QC samples designed to assess blank contamination, analytical precision, and accuracy to identify any limitations in data use and, if known, data bias. The validator will apply qualifiers as needed to reflect any limitations on the use of specific data points and prepare a report detailing the information reviewed, data limitations, and overall usability. Patterns of data use limitations or anomalies which become apparent during the validation process or as the users will be reviewed with the Project QA Manager and the appropriate laboratory. Data that do not meet the quality acceptance limits of Worksheet #28, or quality levels of Worksheet #15, or analytical performance criteria specified in Worksheet #12 will be clearly identified in the database so data users are aware of any limitations associated with data usability. Details of the problems identified during data validation and the bias in the data will be provided in the associated validation memorandum.

Identify the personnel responsible for performing the usability assessment:
Data validation will be performed by AECOM. The usability assessment will be performed jointly by the AECOM and CPG project teams and will include input by field personnel, QA staff, and project management. The data usability will be evaluated in the context of the specific data use objectives for this task.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Data Usability Assessment

The documentation generated during data validation will include a comprehensive memorandum that describes the information reviewed the results of this review and provides a recommendation on overall data usability and limitations on specific data points. The memorandum and associated validation worksheets provide information on the samples included in the review and the date they were collected; the condition of samples when received at the laboratory and any discrepancies noted during the receiving process; verification of sample preparation and analysis within the method specified holding time; instrument calibration information; review of associated QC analyses including blanks, spikes, and field and/or laboratory duplicates; verification of selected reported values from raw data. As a result of this review standard qualifiers are entered into the database so that data users can readily identify any limitations associated with a specific data point.

Assessment of data usability will be performed by AECOM's data validation staff using current USEPA Region II data validation guidance. Note that full method QC elements may be reviewed, however only elements associated with the single target analyte specified in Worksheet #15 are relevant to data qualification. The results of the Data Usability Assessment will be summarized in the final project report. The following items will be assessed and conclusions drawn based on their results:

Holding Time: All sample data will be checked to verify that both sample preparation and analysis were performed within the method required holding time.

Calibration: Data associated with instrument calibration and verification of calibration will be reviewed to confirm that all data were generated using properly calibrated instrumentation.

Accuracy/Bias Contamination: Results for all field blanks, equipment blanks, laboratory MBs, and instrument calibration blanks will be checked against performance criteria specified in Worksheet #28; results for analytes that exceed criteria will be identified and the impact on field sample data will be assessed. Data will be summarized by type of blank.

Accuracy/Bias Overall: Reported values of labeled standard spikes will be evaluated against the spiked concentration and the %R will be calculated and compared to the criteria specified in Worksheet #28. The %R information will be used to assess the bias associated with the analysis. Recovery for labeled standard spikes in conjunction with the recovery reported for the BCS will provide information on the impact of the sample matrix on specific analyses. Average recoveries will be calculated and reported by analyte for each type of QC sample. All results will be recovery corrected based on the principle of isotope dilution.

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Data Usability Assessment

Precision: Results of the RPD will be calculated for each analyte in laboratory and field duplicates. These RPDs will be checked against measurement performance criteria presented on Worksheet #28; RPDs exceeding the stated criteria will be identified. Additionally the combined RPD of each analyte will be averaged across duplicate pairs whose original and duplicate values are both greater than the QL and a combined overall RPD average will be determined for each analyte in both laboratory and field duplicates. This information will be used to draw conclusions about the precision of the analyses and, for field duplicates, the precision of sampling and analysis. Any limitations on the use of the data will also be described.

Sensitivity: During validation, EDLs will be checked against expected achievable QLs presented on Worksheet #15. Sample-specific factors such as analytical dilutions, percent moisture, and sample volume will affect the achievable laboratory limits. All reported analytical results will be evaluated to determine if adequate sensitivity was achieved. The impact on data usability, limitations on the use of the data, and conclusions about the sensitivity of the analysis will be reported.

Representativeness: A review of field records will be used to confirm that sample collection and handling was performed in a manner that conformed to the designated SOP. Similarly laboratory preparation procedures will be reviewed during validation to ensure that a representative sample was selected for analysis. Any deviations or modifications to field or laboratory procedures which might impact the representativeness of the sample will be discussed in the project final report.

Comparability: The analytical procedures which will be used in this program have been selected to ensure that the resulting data will be comparable to data which will be conducted in the future. The passive sampling technique for porewater analysis has not been previously used for the LPR RI/FS. The specific DUOs for this task required minor method modifications. Any modifications or deviations from stated procedures which might impact data comparability will be addressed in the project final report

Completeness: Completeness for the analytical program will be calculated as the number of data points that are accepted as usable based on the validation process divided by the total number of data points for each analysis. Completeness will be reported for each analytical category and an overall value will be reported. As shown in Worksheet #12, the analytical completeness goal is ≥90%. Completeness for the field program will be calculated as the number of samples successfully collected compared to the total number proposed in this QAPP. The completeness goal for the field sampling program is ≥95%.

Each of the objectives presented on Worksheet #11 will be reviewed to determine if the stated objective was met. The major impacts observed from data validation, DQIs and measurement performance criteria assessments will be used to assess the overall data quality and whether these

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Data Usability Assessment

objectives were achieved. The final report will summarize the information used to reconcile each objective and overall conclusions regarding data quality.

Attachment 1

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Appendix A

Bathymetric Survey

Appendix B

Field Standard Operating Procedures

Appendix C

Laboratory Standard Operating Procedures